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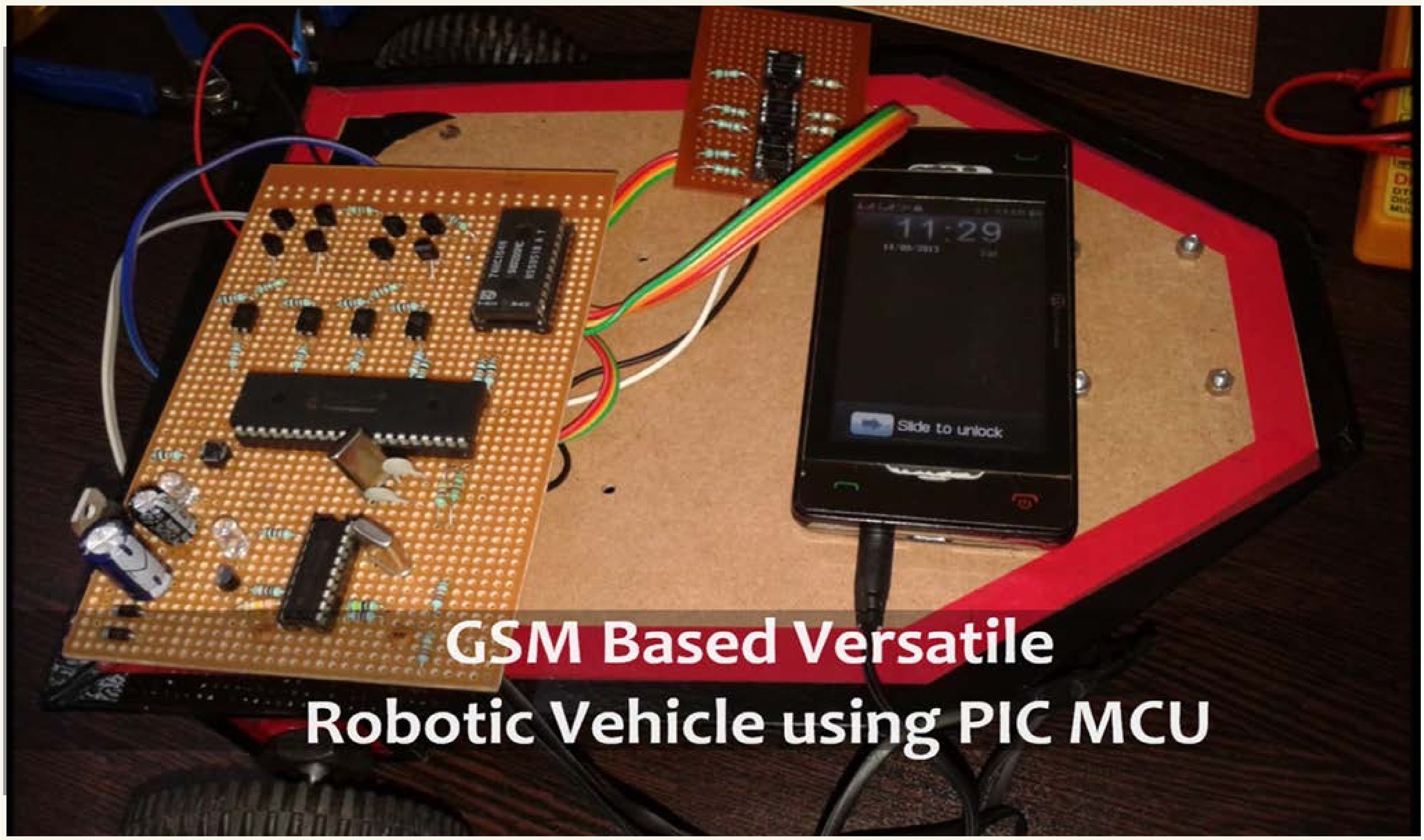
GSM Based Versatile Robotic Vehicle



Project By: Abhi Sharma

GSM BASED VERSATILE ROBOTIC VEHICLE

SUBMITTED BY:

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Chapter 1

Introduction To Robotics

The word ‘Robot’ is one of those elusive terms that have defied unique definition. One reason for this is that its use changes all the time. Initially, a robot was a humanoid or human-like being. The word ‘Robot’ was derived from the Czech word meaning ‘slave labor’ and was coined by Kapec in his play, Rossum’s Universal Robots in 1921. These robots were biochemical – what we would now call androids. This was followed soon after by a number of films featuring robots such as Fritz Lange’s 1922 Metropolis that excited the imagination of both the public and the science and engineering communities. Science fiction books such as Asimov’s ‘I Robot’, from where we got the term robotics, were also popular at this time. These robots were easy to define as non-living machines that looked and acted like humans. In the real world of industry and academia, however, robots were not anything like humanoids. In the academic world, the most advanced robot in the 1970s was the Stanford Cart which had a body made up of what looked like a shallow rectangular box on wheels from an old fashioned baby carriage (pram). In those days the idea was to go for human modes of reasoning, rather than human shapes. Unfortunately, because of the complexity of the models of human, perception-inference-reasoning, this type of robot would move about one meter every 15 minutes. So the 1980s saw a shift towards robot controllers being modeled on insects and other animals and this enabled the sort of fast reactive responses that you can see in modern day toy sensing robots and robot pets. The major uses in industry, e.g. painting cars, required only robot arms rather than whole robots. Initially these were considered to be ‘part of’ a robot’s body but they eventually became known as robots in their own right. The major distinction is now between *non-mobile robots* such as arms and actuators and mobile robots, which may be wheeled, legged or may even be propelled through water or air. Another important distinction is between autonomous and non autonomous robots. Originally, robots would only be considered to be a robot if it was autonomous. That is, they could operate on their own without human intervention. It is now perfectly acceptable to call any autonomous vehicle a mobile robot even if it looks like a car, a plane or a horse. It is also becoming increasingly acceptable to use the term robot for remote controlled vehicles. This started off with tele-robotics, robots operated at a distance, like those

used by emergency services for bomb disposal and firefighting. Then came the remote controlled robot used in television contests like *Robot Wars*, *TechnoGames* and *Mechanoids*.

The 3 Laws of Robotics

Books, movies, stories, and other works of fiction help us think about the real world in new ways. Science fiction has often been inspired by the future possibilities of robotics. However, the relationship betweens science fiction and robotics is a two way street: science fiction affects the field of robotics as well. Early in the history of robots, acclaimed writer Isaac Asimov became concerned that humanity was unprepared for what he saw as the inevitable: robots becoming an integral part of society in the future. In 1942, he created a 3-point code of conduct for the 21st century robots written about in his many books. We call these **Asimov's Laws of Robotics**:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders conflict with the first law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second law.

Basic Parts of a Robot Vehicle:

Basically a robot consists of the following basic, yet important parts –

- A mechanical device, such as a wheeled platform, arm, or other construction, capable of interacting with its environment.
- Sensors on or around the device those are able to sense the environment and give useful feedback to the device.
- Systems that process sensory input in the context of the device's current situation and instruct the device to perform actions in response to the situation.

In the manufacturing field, robot development has focused on engineering robotic arms that perform manufacturing processes. In the space industry, robotics focuses on highly specialized, one-of-kind planetary rovers. Unlike a highly automated manufacturing plant, a planetary rover operating on the dark

side of the moon - without radio communication - might run into unexpected situations. At a minimum, a planetary rover must have some source of sensory input, some way of interpreting that input, and a way of modifying its actions to respond to a changing world. Furthermore, the need to sense and adapt to a partially unknown environment requires intelligence (in other words, artificial intelligence). From military technology and space exploration to the health industry and commerce, the advantages of using robots have been realized to the point that they are becoming a part of our collective experience and everyday lives.

They often function to relieve us from danger and tedium:

Safety - Robotics have been developed to handle nuclear and radioactive chemicals for many different uses including nuclear weapons, power plants, environmental cleanup, and the processing of certain drugs.

Unpleasantness - Robots perform many tasks that are tedious and unpleasant, but necessary, such as welding or janitorial work.

Repetition and Precision - Assembly line work has been one of the mainstays of the robotics industry. Robots are used extensively in manufacturing and, more glamorously, in space exploration, where minimum maintenance requirements are emphasized.

Mechanical Platforms - The Hardware Base

A robot consists of two main parts - the robot body and some form of artificial intelligence (AI) system. Many different body parts can be called a robot. Articulated arms are used in welding and painting; gantry and conveyor systems move parts in factories; and giant robotic machines move earth deep inside mines. One of the most interesting aspects of robots in general is their behavior, which requires a form of intelligence. The simplest behavior of a robot is locomotion. Typically, wheels are used as the underlying mechanism to make a robot move from one point to the next. Of course, some motive force required to make the wheels turn under command.

Motors

A variety of electric motors provide power to robots, allowing them to move material, parts, tools, or specialized devices with various programmed motions. The efficiency rating of a motor describes how much of the electricity consumed is converted to mechanical energy. Some of the mechanical devices that are currently being used in modern robotics technology include:

DC Motor - Permanent magnet, direct-current (PMDC) motors require only two leads, and use an arrangement of fixed- and electro-magnets (stator and rotor) and switches. These form a commutator to create motion through a spinning magnetic field.

AC Motor - AC motors cycle the power at the input-leads, to continuously move the field. Given a signal, AC and DC motors perform their action to the best of their ability.

Stepper Motor - Stepper motors are like brushless DC or AC motors. They move the rotor by applying power to different magnets in the motor in sequence (stepped). Steppers are designed for fine control and will not only spin on command, but can spin at any number of steps-per-second (up to their maximum speed).

Servomotors - Servomotors are closed-loop devices. Given a signal, they adjust themselves until they match the signal. Servos are used in radio control airplanes and cars. They are simple DC motors with gearing and a feedback control system.

Driving Mechanisms

Gears and Chains - Gears and chains are mechanical platforms that provide a strong way to transmit rotary motion from one place to another, possibly changing it along the way. The speed change between two gears depends upon the number of teeth on each gear. When a powered gear goes through a full rotation, it pulls the chain by the number of teeth on that gear.

Pulleys and Belts - Pulleys and belts, two other types of mechanical platforms used in robots, work the same way as gears and chains. Pulleys are wheels with

a groove around the edge, and belts are the rubber loops that fit in that groove.

Gearboxes - A gearbox operates on the same principles as the gear and chain, without the chain. Gearboxes require closer tolerances, since instead of using a large loose chain to transfer force and adjust for misalignments; the gears mesh directly with each other. Examples of gearboxes can be found on the transmission in a car, the timing mechanism in a grandfather clock, and the paper-feed of your printer.

Power Supplies

Two types of battery generally provide power supplies. Primary batteries are used once and then discarded; secondary batteries operate from a (mostly) reversible chemical reaction and can be recharged several times. Primary batteries have higher density and a lower self-discharge rate. Secondary (rechargeable) batteries have less energy than primary batteries, but can be recharged up to a thousand times depending on their chemistry and environment. There are literally hundreds of types and styles of batteries available for use in robots. Batteries are categorized by their chemistry and size, and rated by their voltage and capacity. The voltage of a battery is determined by the chemistry of the cell, and the capacity by both the chemistry and size. The robot platform runs off of two separate battery packs, which share only a ground. This way, the motor may dirty up one power source while the electronics can run off of the other. The electronics and the motors can also operate from different voltages.

Electronic Control

There are two major hardware platforms in a robot. The mechanical platform of unregulated voltages, power and back-EMF spikes, and the electronic platform of clean power and 5-volt signals. These two platforms need to be bridged in order for digital logic to control mechanical systems. The classic component for this is a bridge relay. A control signal generates a magnetic field in the relay's coil that physically closes a switch. MOSFETs, for example, are highly efficient silicon switches, available in many sizes like the transistor that can operate as a solid-state relay to control the mechanical systems. On the other hand, larger sized robots may require a PMDC motor in which the value of the MOSFET's "on" resistance Rds(on) results in great increases in the heat

dissipation of the chip, thereby significantly reducing the chip's heat temperature. Junction temperatures within the MOSFET and the coefficients of conduction of the MOSFET package and heat sink are other important characteristics of PMDC motors. There are two broad families of transistor - bipolar junction transistors (BJT) and field-effect transistors (FET). In BJT devices, a small current flow at the base moderates a much larger current between the emitter and collector. In FET devices, the presence of an electrical field at the gate moderates the flow between the source and drain.

Sensors

Robots react according to a basic temporal measurement, requiring different kinds of sensors. In most systems a sense of time is built in through the circuits and programming. For this to be productive in practice, a robot has to have perceptual hardware and software, which is updated quickly. Regardless of sensor hardware or software, sensing and sensors can be thought of as interacting with external events (in other words, the outside world). The sensor measures some attribute of the world. The term transducer is often used interchangeably with sensor. A transducer is the mechanism, or element, of the sensor that transforms the energy associated with what is being measured into another form of energy. A sensor receives energy and transmits a signal to a display or computer. Sensors use transducers to change the input signal (sound, light, pressure, temperature, etc.) into an analog or digital form Capable of being used by a robot.

Logical Sensors - One powerful abstraction of a sensor is a logical sensor, which is a unit of sensing or module that supplies a particular percept. It consists of the signal processing, from the physical sensor, and the software processing needed to extract the percept.

Proprioceptive Sensors - Proprioception is dead reckoning, where the robot measures a signal originating within itself.

Proximity Sensors - A proximity sensor measures the relative distance between the sensor and objects in the environment.

Infrared (IR) Sensors - Another type of active proximity sensor is an infrared sensor.

It emits near-infrared energy and measures whether any significant amount of the IR light is returned.

Bump and Feeler Sensors Another popular class of robotic sensing is tactile, or touchbased, done with a bump and feeler sensor. Feelers or whiskers are constructed from sturdy wires. A bump sensor is usually a protruding ring around the robot consisting of two layers.

Microcontroller Systems

Microcontrollers (MCUs) are intelligent electronic devices used inside robots. They deliver functions similar to those performed by a microprocessor (central processing unit, or CPU) inside a personal computer. MCUs are slower and can address less memory than CPUs, but are designed for real-world control problems. One of the major differences between CPUs and MCUs is the number of external components needed to operate them. MCUs can often run with zero external parts, and typically need only an external crystal or oscillator. There are four basic aspects of a microcontroller - speed, size, memory, and other. Speed is designated in clock cycles, and is usually measured in millions of cycles per second (Megahertz, MHz). The use of the cycles varies in different MCUs, affecting the usable speed of the processor. Size specifies the number of bits of information the MCU can process in one step - the size of its natural cluster of information. MCUs come in 4-, 8-, 16-, and 32-bits, with 8-bit MCUs being the most common size. MCUs count most of their ROM in thousands of bytes (KB) and RAM in single bytes. Many MCUs use the Harvard architecture, in which the program is kept in one section of memory (usually the internal or external SRAM). This in turn allows the processor to access the separate memories more efficiently. The fourth aspect of microcontrollers, referred to as "other", includes features such as a dedicated input device that often (but not always) has a small LED or LCD display for output. A microcontroller also takes input from the device and controls it by sending signals to different components in the device. Also the program counter keeps track of which command is to be executed by the microcontroller.

R/C Servos - Servomotors, used in radio-controlled models (cars, planes, etc.) are useful in many kinds of smaller robots, because they are compact and quite inexpensive. The servomotors themselves have built-in motor, gearbox, position feedback mechanisms and controlling electronics. Standard radio

control servomotors, which are used in, model airplanes, cars and boats are useful for making arms, legs and other mechanical appendages which move back and forth rather than rotating in circles.

Wide World Of Robots

Around the globe, robots are becoming familiar parts of our working lives. Japan is a world leader in robotics. They have 400,000 robots working in factories - 10 times as many as the United States. Robots are used in dozens of other countries. As robots become more common, and less expensive to make, they will continue to increase their numbers in the workforce. Naturally, this is a matter of concern for factory workers, who may see their positions filled by robotic systems.

Chapter 2

Overview Of Project

Block diagram of Mobile Controlled Robot –

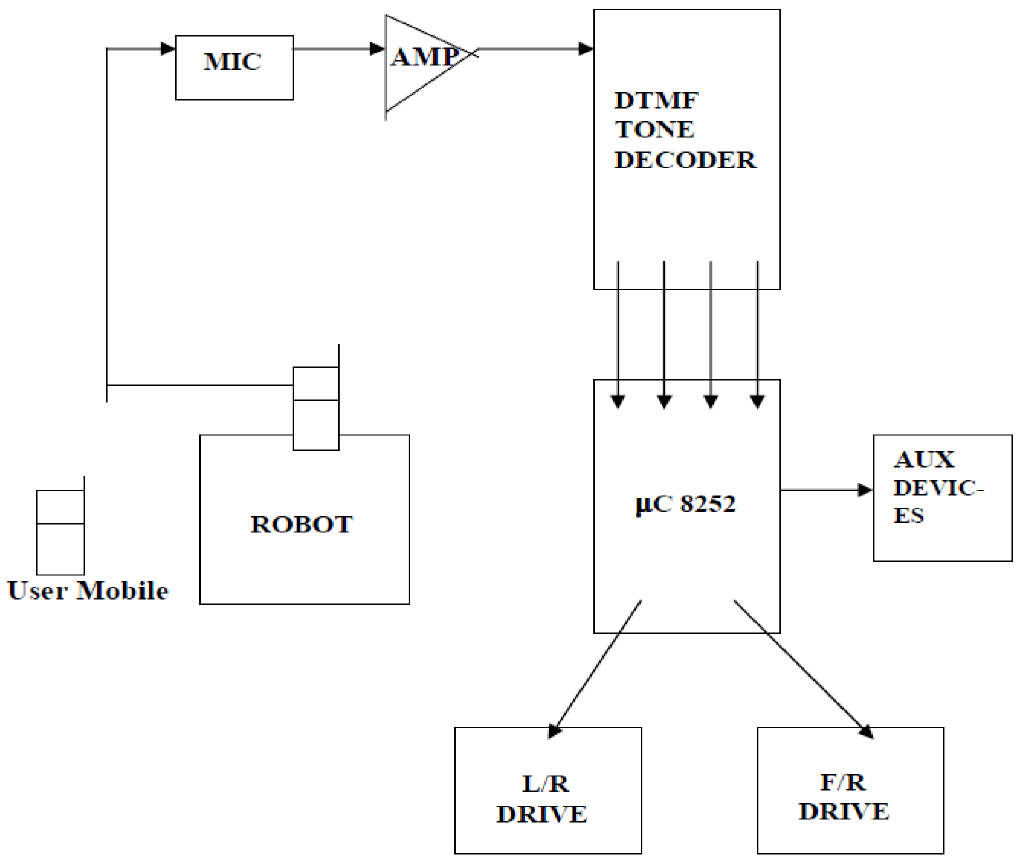
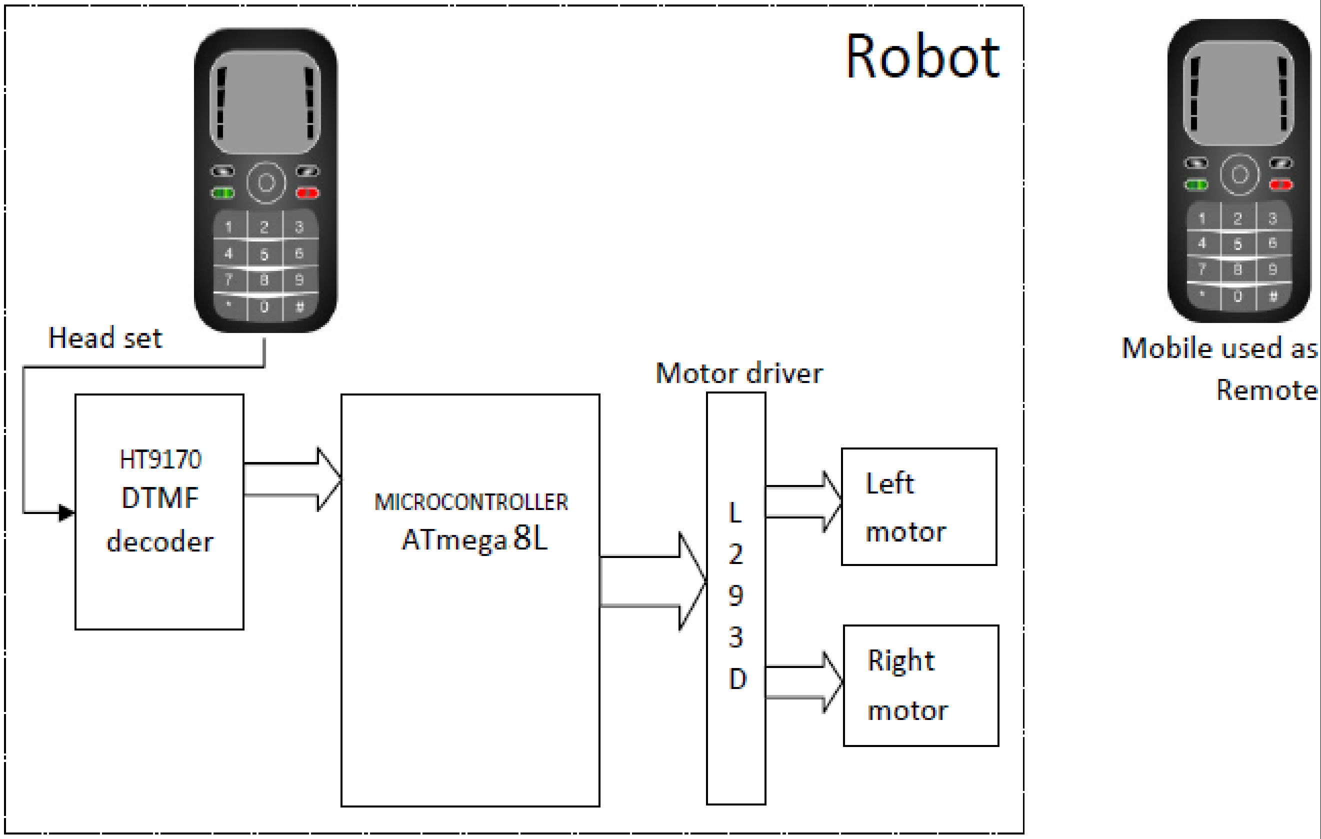


Fig 2.Basic block diagram



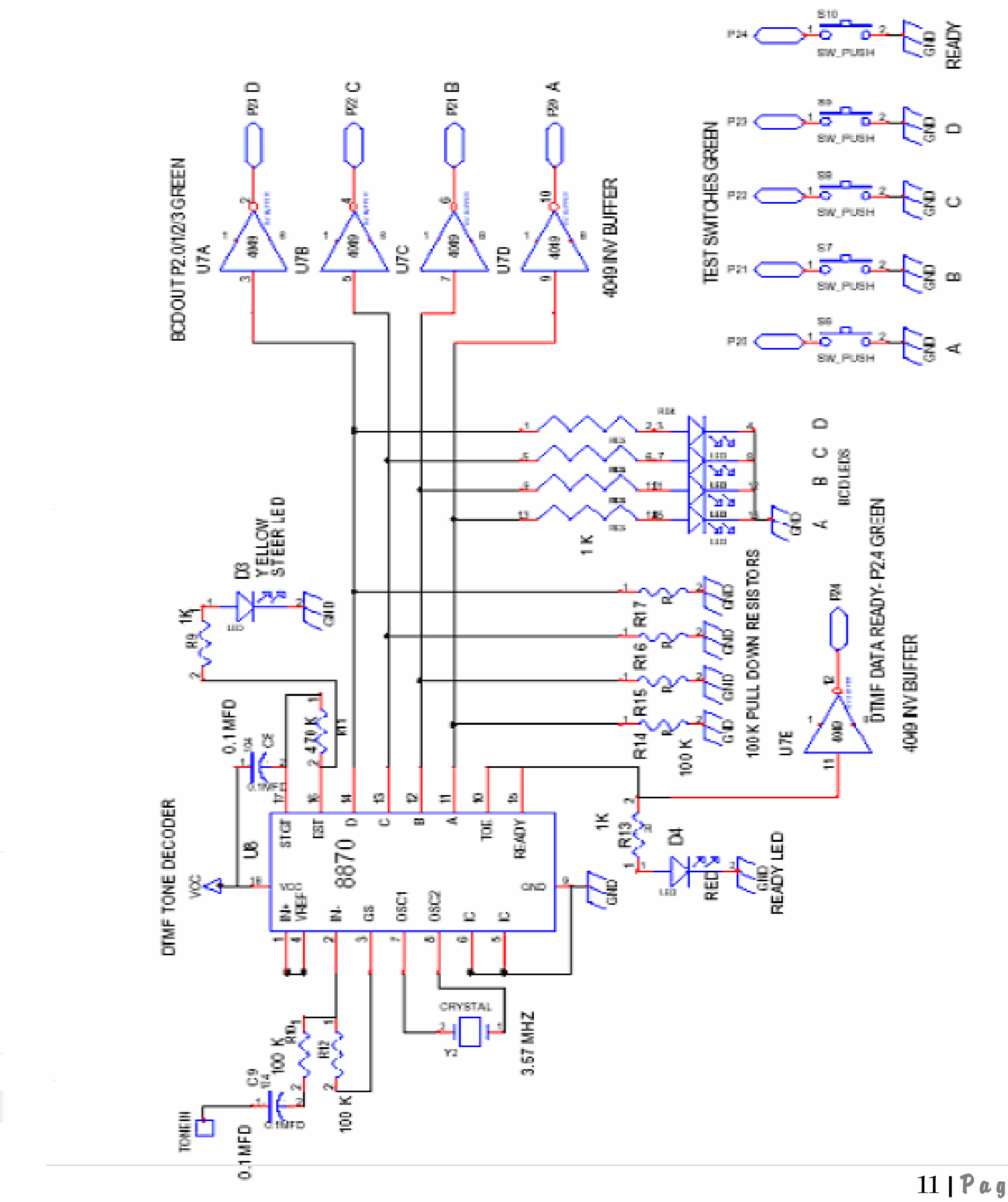
For Example:

Let key 2 be assigned for forward motion, key 4 for left, key 6 for right and key 8 for backward motion. When forward motion is required, a call is established and key 2 is pressed. The DTMF circuit picks up the frequency and determines that key 2 has been pressed. This is fed to the micro controller in the form of an 8421 code i.e. 0010. The micro controller, which has been pre-programmed, gives the signal to the motor to move forward.

Chapter 3

Schematics Of Project

DTMF CIRCUIT:



A row and column grid looks like this.

1	2	3	597hz
4	5	6	770hz
7	8	9	852hz
*	0	#	941hz
1209hz	1336hz	1477hz	

8870 – DTMF Receiver and Decoder

Features:

- Complete DTMF receiver
- Low power consumption
- Internal gain setting amplifier
- Adjustable guard time
- Central office quality
- Power down mode
- Inhibit mode
- Backward compatible with 8870C/8870C-1

Applications:

- Receiver system for British telecom
- Repeater systems/Mobile radio
- Credit card systems
- Remote control
- Personal computers
- Telephone answering machine

Description:

The 8870D/8870D-1 is a complete DTMF receiver integrating both the band split Filter and digital decoder functions. The filter section uses switched capacitor techniques for high and low group filters; the decoder uses digital counting techniques to detect and decode all 16 DTMF tone pairs into a 14 bit code. External component count is minimized by on chip provision of a

differential input amplifier, clock oscillator and latched three state bus interface.

Pin Description:

Pin # 18	Pin # 20	Name	Description
1	1	IN+	**Non-Inverting Op-Amp (Input)**.
2	2	IN-	**Inverting Op-Amp (Input)**.
3	3	GS	**Gain Select.** Gives access to output of front end differential amplifier for connection of feedback resistor.
4	4	V_{Ref}	**Reference Voltage (Output).** Nominally $V_{DD}/2$ is used to bias inputs at mid-rail (see Fig. 6 and Fig. 10).
5	5	INH	**Inhibit (Input).** Logic high inhibits the detection of tones representing characters A, B, C and D. This pin input is internally pulled down.
6	6	PWDN	**Power Down (Input).** Active high. Powers down the device and inhibits the oscillator. This pin input is internally pulled down.
7	8	OSC1	**Clock (Input)**.
8	9	OSC2	**Clock (Output)**. A 3.579545 MHz crystal connected between pins OSC1 and OSC2 completes the internal oscillator circuit.
9	10	V_{SS}	**Ground (Input)**. 0V typical.
10	11	TOE	**Three State Output Enable (Input).** Logic high enables the outputs Q1-Q4. This pin is pulled up internally.
11-14	12-15	Q1-Q4	**Three State Data (Output).** When enabled by TOE, provide the code corresponding to the last valid tone-pair received (see Table 1). When TOE is logic low, the data outputs are high impedance.
15	17	StD	**Delayed Steering (Output).**Presents a logic high when a received tone-pair has been registered and the output latch updated; returns to logic low when the voltage on St/GT falls below V_{TSt}.
16	18	ESt	**Early Steering (Output).** Presents a logic high once the digital algorithm has detected a valid tone pair (signal condition). Any momentary loss of signal condition will cause ESt to return to a logic low.
17	19	St/GT	**Steering Input/Guard time (Output) Bidirectional.** A voltage greater than V_{TSt} detected at St causes the device to register the detected tone pair and update the output latch. A voltage less than V_{TSt} frees the device to accept a new tone pair. The GT output acts to reset the external steering time-constant; its state is a function of ESt and the voltage on St.
18	20	V_{DD}	**Positive power supply** (**Input**). +5V typical.
	7, 16	NC	No Connection.

Table 1. Pin Description of 8870

Functional Block Diagram:

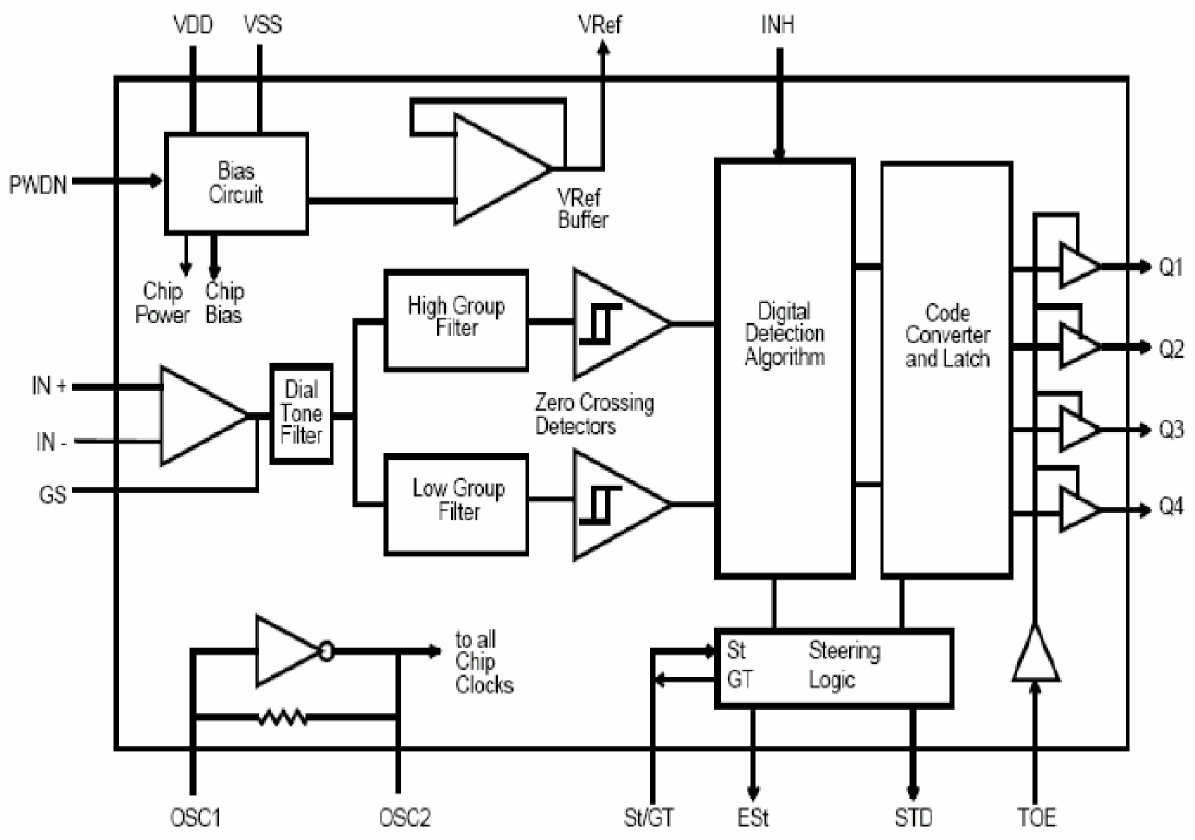


Fig 5.Functional block diagram of DTMF

Functional Description:

The MT8870D/MT8870D-1 monolithic DTMF receiver offers small size, low power consumption and high performance. Its architecture consists of a band split filter section, which separates the high and low group tones, followed by a digital counting section which verifies the frequency and duration of the received tones before passing the corresponding code to the output bus.

Filter Section

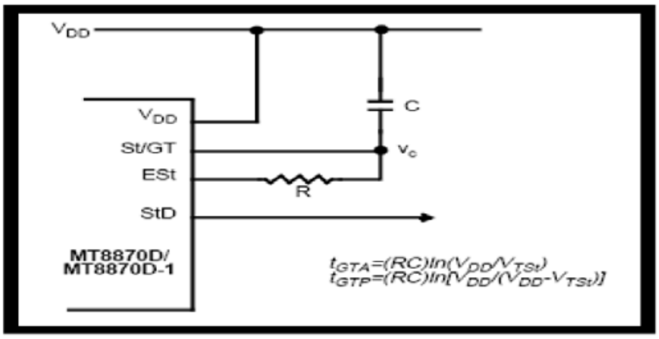
Separation of the low-group and high group tones is achieved by applying the DTMF signal to the inputs of two sixth-order switched capacitor bandpass filters, the bandwidths of which correspond to the low and high group frequencies. The filter section also incorporates notches at 350 and 440 Hz for

exceptional dial tone rejection. Each filter output is followed by a single order switched capacitor filter section, which smooth the signals prior to limiting. Limiting is performed by high gain comparators, which are provided with hysteresis to prevent detection of unwanted low-level signals. The outputs of the comparators provide full rail logic swings at the frequencies of the incoming DTMF signals.

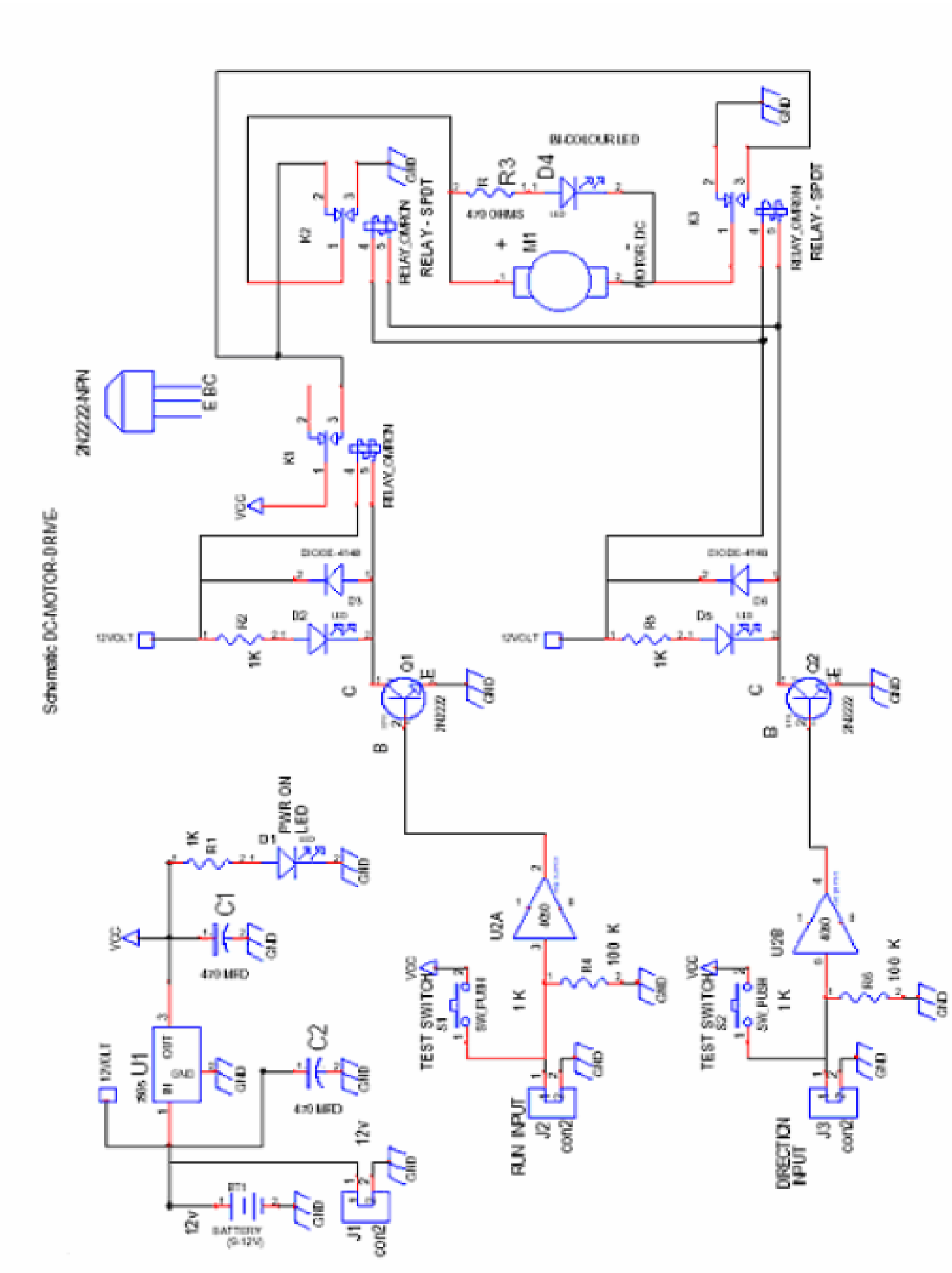
Decoder Section

Following the filter section is a decoder employing digital counting techniques to determine the frequencies of the incoming tones and to verify that they correspond to standard DTMF frequencies. A complex averaging algorithm protects against tone simulation by extraneous signals such as voice while providing tolerance to small frequency deviations and variations. This averaging algorithm has been developed to ensure an optimum combination of immunity to talk-off and tolerance to the presence of interfering frequencies (third tones) and noise. When the detector recognizes the presence of two valid tones (this is referred to as the “signal condition” in some industry specifications) the “Early Steering” (ESt) output will go to an active state. Any subsequent loss of signal condition will cause ESt to assume an inactive state (see “Steering Circuit”).

Steering Circuit:



DC MOTOR DRIVE:



Working Of DC Motor Drive Circuit :

The circuit uses 7805 for a stabilized 5v dc supply with a ripple smoothening capacitor C1. Input to the circuit is 12v dc. A power ON indicator led D1 is used with a current limiting resistor R1.The circuit has two logic inputs marked as RUN and DIRECTION.

A dc motor rated at 5v is connected using two 12volt relays for direction change and another relay is used to supply power to the motor. When the DIR relay (k1 12v) is ON, power supply (5v) goes to the DC motor where the direction is in one way. When the DIR relay and relays K2 K3 are energized the motor runs in the other way because of the connection change in polarity.
If only the DIR relay is energized - the motor does not rotate because the supply is cut off by relay K1. Relay energizing indicator is also provided through an LED & back emf diodes (1N4148) are placed across relay coils. As shown in the schematic logic input connectors are provided through two-way cables into the PCB. Two non-inverting buffers IC 4050 are used with pull down resistors (100k) to keep the logic low. When testing without the sensors two-test switches is also provided to simulate the input action, the output of 4050 is used to bias the transistors. No bias resistor is used, since the ic4050 has built in 330 ohms resistors as per CMOS logic gate standards.

Working Of DC Motor’s Steering Circuit :

The circuit uses 7805 for a stabilized 5V dc supply with a ripple smoothening capacitor C1. Input to the circuit is 12v dc. A power ON indicator led D1 is used with a current limiting resistor R1. The steering mechanism has a built in dc motor rated at 5V, which consume approximately 100mA current. When the motor is rotated in one direction for one second the steering mechanism moves 2 wheels in one angle.

If the polarity is reversed to the motor the wheels move in other direction. The motor has a gear/ clutch mechanism built in, so, even if the power is given for greater than one second the clutch slips & does damage the motor.

To operate this dc motor we require 2 SPDT relays, which can supply power of either polarity of dc motor. When any one of them is energized see (relay k1 & k2) (in schematic) R3 & D4 (bicolor LED) one placed across the motor to indicate red/ green to show the clockwise/ anticlockwise rotation. Since the 2

relays provide opposite polarity voltage to the steering motor only one relay at a time should be energized.

When both the relays are ON or OFF, no power is supplied to the motor. Relay energizing indicator is also provided through an LED & back emf diodes (1N4148) are placed across relay coils. As shown in schematic, left & right logic input connectors are used which can be connected through two-way cables into the PCB. Two non-inverting buffers IC 4050 are used with pull down resistors (100k) to keep the logic low.

When testing without the sensors two test switches are also provided to simulate the sensor action, the output of 4050 is used to bias the transistors. No bias resistor is used, since the IC 4050 has built in 330 ohms resistors as per CMOS logic gate standards.

Chapter 4

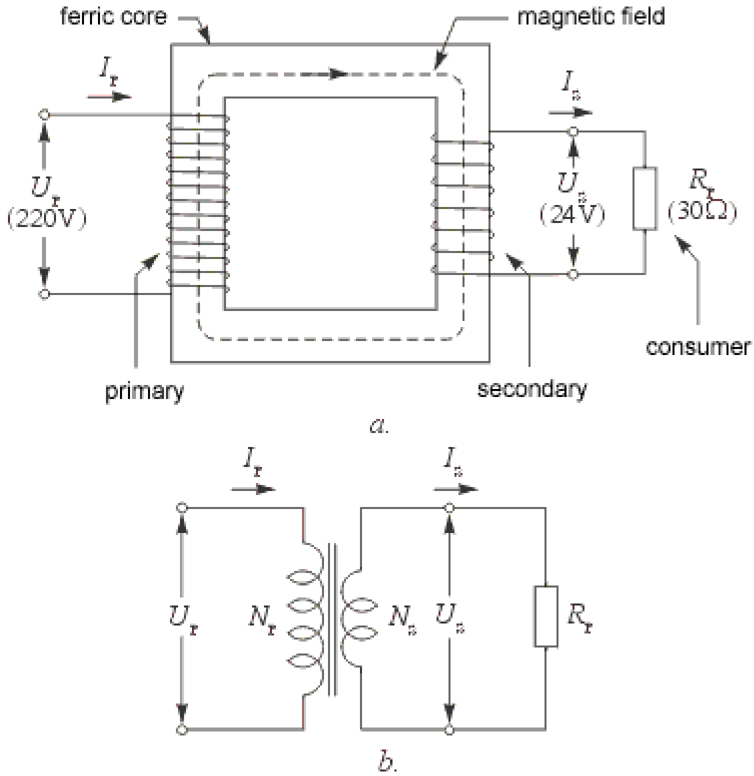
Components Used:

It's a wireless controlled robot. In this we are utilizing the concept of GSM communication. It's a wireless robot, which is controlled by our general mobile hand set. It works according to the commands given by our mobile set. It uses two mobile sets. One at receiver end, which is attached with the appliances (used as a receiver) and second at user end (which is used as transmitter). Its a one way communication in this project receiver does not send any command or feedback to the transmitter. A link between the transmitter and receiver is established by a general mobile communication and at general call charges. When a link between transmitter and receiver is established then we can control our robot from our mobile handset. At the receiver end receiver receives commands, decode it and act according to that. With the help of this we can move our robot to any direction.

TRANSFORMER

Transformer works on the principle of mutual inductance. We know that if two coils or windings are placed on the core of iron, and if we pass alternating current in one winding, back emf or induced voltage is produced in the second winding. We know that alternating current always changes with the time. So if we apply AC voltage across one winding, a voltage will be induced in the other winding. Transformer works on this same principle. It is made of two windings wound around the same core of iron. The winding to which AC voltage is applied is called primary winding. The other winding is called as secondary

winding. Transformers are of two types Step Up transformer and Step Down transformer.



Step Up transformer: -

These transformers are used to increase the voltage level at the output means Voltage at secondary winding is more than the primary winding. In this transformer secondary winding has more number of turns than primary winding. These types of transformers are generally used in power station.

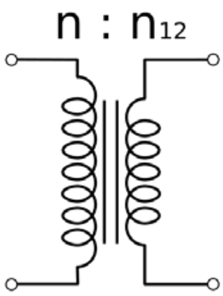
Step Down transformer: -

These transformers are used to decrease the voltage level at the output winding means voltage of secondary winding is less than the primary winding. In this transformer secondary winding has less number of turns than primary winding These types of transformers have major applications in electronics industry. Further these are divided into two categories

A) Simple Transformer

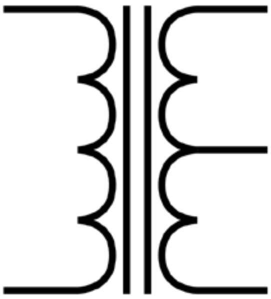
B) Central tapped transformer

Simple Transformer: - It's a four wire transformer. These types of transformer have 2 wires on primary winding and 2 wires on secondary output. Symbol of this transformer is shown below. Voltage rating of these transformer expressed as 6V,12V, 24V etc.



Central Tapped transformer: - It's a 5 Wire transformer. This type of transformer has 2 wires on primary winding and 3 wires on secondary. Middle one is known as Common. Voltage rating of these transformer expressed as 6-0-6 V, 12-0-12 V, 24-0-24 V etc.

Specification of transformer Of Tapped transformer



While purchasing a transformer generally two considerations have to be kept in mind, first one is voltage rating and second is current rating. Voltage rating depends upon the circuit's operating voltage its generally 5 or 12 Volt so 6 or 12 Volt transformers are generally used. Current rating of transformer depends upon the load of circuit. If our load current is more than the transformer current then due to loading effects transformer can burn out. So to protect our transformer, current rating of transformer should be more than the load current. All transformer comes with different current rating e.g. 6 V transformer is available in 500m A, 750mA, 1A, 2A so on. One thing should be kept in

mind as the ampear increases cost of transformer also increases. We have to choose best one according to our circuit requirements.

RESISTORS

The flow of charge (or current) through any material, encounters an opposing force similar in many respect to mechanical friction. This opposing force is called resistance of the material. It is measured in ohms. In some electric circuits resistance is deliberately introduced in the form of the resistor.

Resistors are of following types:

1. Wire wound resistors.
2. Carbon resistors.
3. Metal film resistors.

Wire Wound Resistors:

Wire wound resistors are made from a long (usually Ni-Chromium) wound on a ceramic core. Longer the length of the wire, higher is the resistance. So depending on the value of resistor required in a circuit, the wire is cut and wound on a ceramic core. This entire assembly is coated with a ceramic metal. Such resistors are generally available in power of 2 watts to several hundred watts and resistance values from 1ohm to 100k ohms. Thus wire wound resistors are used for high currents.

Carbon Resistors:

Carbon resistors are divided into three types:

a. Carbon composition resistors are made by mixing carbon grains with binding material (glue) and moduled in the form of rods. Wire leads are inserted at the two ends. After this an insulating material seals the resistor. Resistors are available in power ratings of 1/10, 1/8, 1/4 , 1/2 , 1.2 watts and values from 1 ohm to 20 ohms.

b. Carbon film resistors are made by deposition carbon film on a ceramic rod. They are cheaper than carbon composition resistors.

c. Cement film resistors are made of thin carbon coating fired onto a solid ceramic substrate. The main purpose is to have more precise resistance values and greater stability with heat. They are made in a small square with leads.

Metal Film Resistors:

They are also called thin film resistors. They are made of a thin metal coating deposited on a cylindrical insulating support. The high resistance values are not precise in value; however, such resistors are free of inductance effect that is common in wire wound resistors at high frequency.

Variable Resistors:

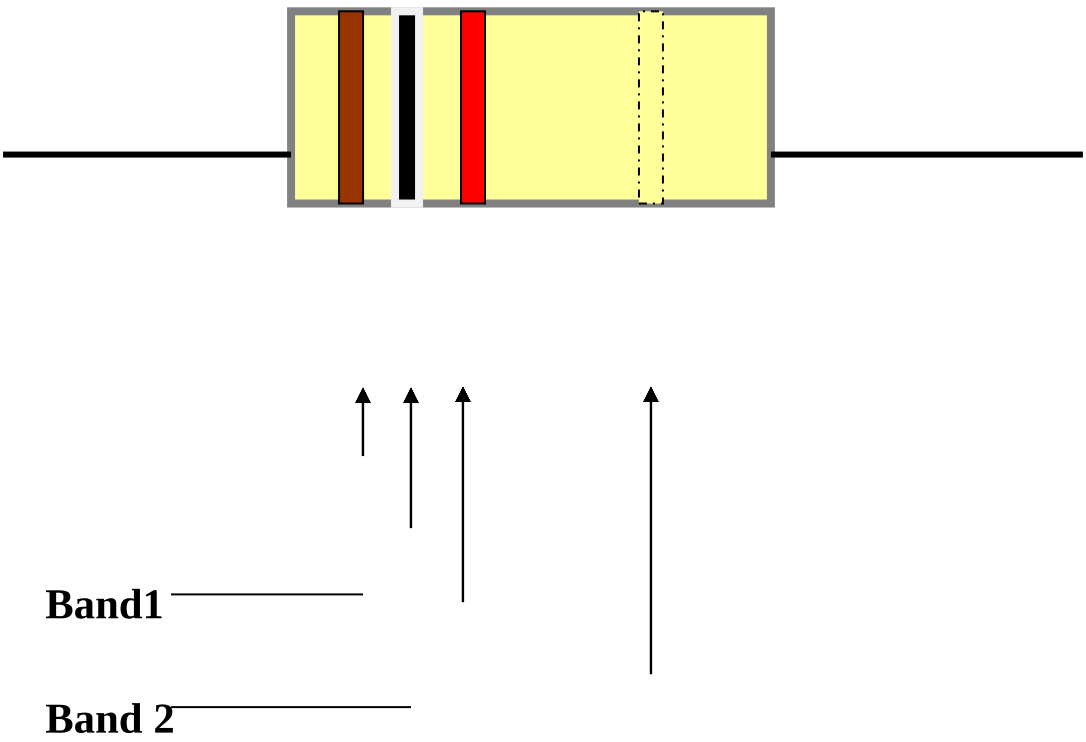
Potentiometer is a resistor where values can be set depending on the requirement. Potentiometer is widely used in electronics systems. Examples are volume control, tons control, brightness and contrast control of radio or T.V. sets.

RESISTOR COLOR CODE

Colour	1^{st} band	2^{nd} band	3^{rd} band (multiplier)	4^{th} band (tolerance)	Temp. Coefficient
Black	0	0	$\times10^{0}$		
Brown	1	1	$\times10^{1}$	±1% (F)	100 ppm
Red	2	2	$\times10^{2}$	±2% (G)	50 ppm
Orange	3	3	$\times10^{3}$		15 ppm
Yellow	4	4	$\times10^{4}$		25 ppm
Green	5	5	$\times10^{5}$	±0.5% (D)	

Blue	6	6	$\times 10^{6}$	±0.25% (C)	
Violet	7	7	$\times 10^{7}$	±0.1% (B)	
Gray	8	8	$\times 10^{8}$	±0.05% (A)	
White	9	9	$\times 10^{9}$		
Gold			$\times 10^{-1}$	±5% (J)	
Silver			$\times 10^{-2}$	±10% (K)	
None				±20% (M)	

Example: 1k or 1000 ohms

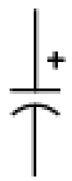


Band 3 ____________________

Band 4 ________________________________

CAPACITORS

A capacitor can store charge, and its capacity to store charge is called capacitance. Capacitors consist of two conducting plates, separated by an insulating material (known as dielectric). The two plates are joined with two leads. The dielectric could be air, mica, paper, ceramic, polyester, polystyrene, etc. This dielectric gives name to the capacitor. Like paper capacitor, mica capacitor etc.



Types of Capacitors:- Capacitors are of two Types Fixed and variable capacitor.

Fixed types of capacitor are further of two types:-

Polar Capacitor:- Those capacitor have polarity are known as polar capacitor. Electrolytic capacitor are the example of polar capacitors.

Non Polar Capacitor:- Those capacitor have no polarity are known as NON-polar capacitor. Ceramic capacitor are the example of non polar capacitors

Electrolytic Capacitor: Electrolytic capacitors have an electrolyte as a dielectric. When such an electrolyte is charged, chemical changes takes place in the electrolyte. If its one plate is charged positively, same plate must be charged positively in future. We call such capacitors as polarized. Normally we see electrolytic capacitor as polarized capacitors and the leads are marked with positive or negative on the can. Non-electrolyte

capacitors have dielectric material such as paper, mica or ceramic. Therefore, depending upon the dielectric, these capacitors are classified.

Ceramic Capacitor: Such capacitors have disc or hollow tabular shaped dielectric made of ceramic material such as titanium dioxide and barium titanate. Thin coating of silver compounds is deposited on both sides of dielectric disc, which acts as capacitor plates. Leads are attached to each sides

of the dielectric disc and whole unit is encapsulated in a moisture proof coating. Disc type capacitors have very high value up to 0.001uf. Their working voltages range from 3V to 60000V. These capacitors have very low leakage current. Breakdown voltage is very high.

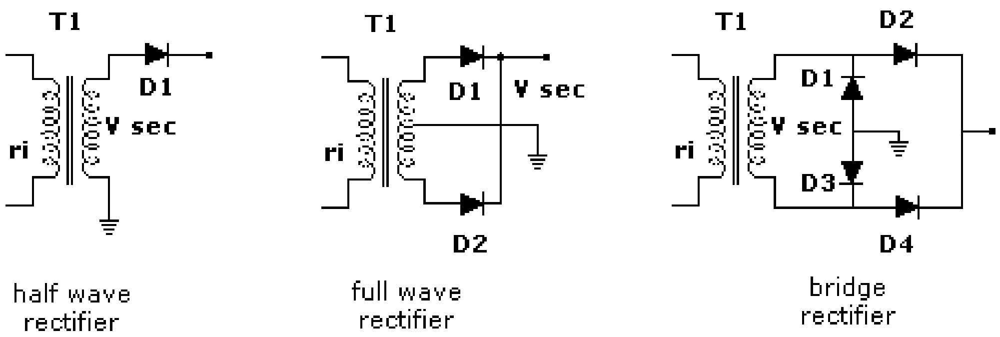
Diode:-

Diodes are semiconductor devices which might be described as passing current in one direction only. Diodes have two terminal, an anode and a cathode. The cathode is always identified by a dot, ring or some other mark. Diode is a unidirectional device. In this current flows in only one direction.

Diodes can be used as voltage regulators, tuning devices in rf tuned circuits, frequency multiplying devices in rf circuits, mixing devices in rf circuits, switching applications or can be used to make logic decisions in digital circuits. There are also diodes which emit "light", of course these are known as light-emitting-diodes or LED's.

A rectifying diode of the 1N4001-07 (1A) type or even one of the high power, high current stud mounting types. You will notice the straight bar end has the letter "k", this denotes the "cathode" while the "a" denotes anode. Current can only flow from anode to cathode and not in the reverse direction, hence the "arrow" appearance. This is one very important property of diodes.

The principal early application of diodes was in rectifying 50 / 60 Hz AC mains to raw DC which was later smoothed by choke transformers and / or capacitors. This procedure is still carried out today and a number of rectifying schemes for diodes have evolved, half wave, full wave and bridge, full wave and bridge rectifiers.



As examples in these applications the half wave rectifier passes only the positive half of successive cycles to the output filter through D1. During the negative part of the cycle D1 does not conduct and no current flows to the load. In the full wave application it essentially is two half wave rectifiers combined and because the transformer secondary is centre tapped, D1 conducts on the positive half of the cycle while D2 conducts on the negative part of the cycle. Both add together. This is more efficient. The full wave bridge rectifier operates essentially the same as the full wave rectifier but does not require a centre tapped transformer. Further discussion may be seen on the topic power supplies.

1N400X series Diode:-

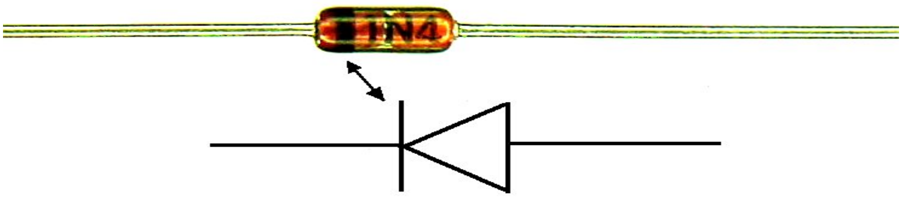
Features

- Diffused Junction
- High Current Capability and Low Forward Voltage Drop
- Low Reverse Leakage Current
- Lead Free Finish

1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	Unit
50	100	200	400	600	800	1000	V

1N4148 Diode

The 1N4148 and 1N4448 are high-speed switching diodes fabricated in planar technology, and encapsulated in hermetically sealed leaded glass SOD27 (DO-35) packages.



FEATURES

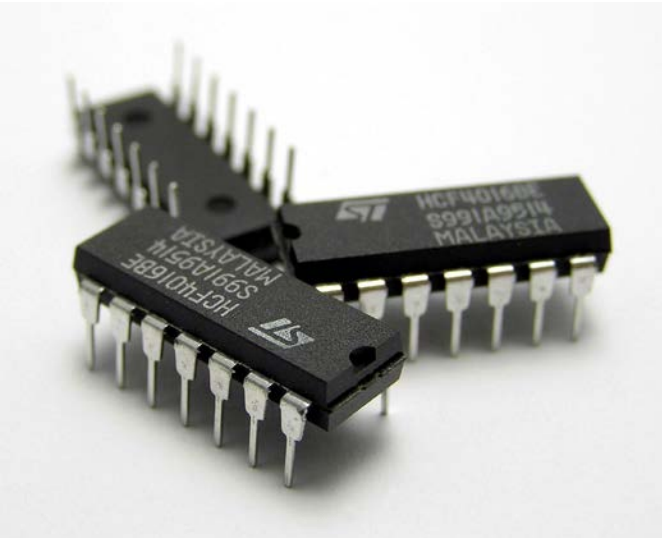
- Hermetically sealed leaded glass SOD27 (DO-35) package
- High switching speed: max. 4 ns
- General application
- Continuous reverse voltage: max. 100 V
- Repetitive peak reverse voltage: max. 100 V
- Repetitive peak forward current: max. 450 mA.

APPLICATIONS

- High-speed switching

IC

IC (Integrated Circuit) means that all the components of the circuit are fabricated on same chip. Digital ICs are a collection of resistors, diodes, and transistors fabricated on a single piece of semiconductor, usually silicon called a substrate, which is commonly referred to as 'wafer'. The chip is enclosed in a protective plastic or ceramic package from which pins extend out connecting the IC to other device. Suffix N or P stands for dual-in-line (plastic package (DIP) while suffix J or I stands for dual-in-lime ceramic package. Also the suffix for W stands for flat ceramic package.



The pins are numbered counter clockwise when viewed from the top of the package with respect to an identity notch or dot at one end of the chip. The manufacturer's name can usually be guessed from its logo that is printed on the IC. The IC type number also indicates the manufacturer's code. For e.g. DM 408 N SN 7404 indicates National Semiconductor and Texas Instruments.

Other examples are:

Fair Child	: UA, UAF
National Semiconductor	: DM, LM, LH, LF, and TA.
Motorola	: MC, MFC.
Sprague	: UKN, ULS, ULX.

Signetic : N/s, NE/SE, and SU.

Burr-Brown : BB.

Texas Instruments : SN.

The middle portion i.e. the IC type number tells about the IC function and also the family, which the particular IC belongs to.IC’s that belongs to standard TTL series have an identification number that starts with 74; for e.g. 7402, 74LS04, 74S04 etc. IC’s that belongs to standard CMOS family their number starts with 4, like 4000, 451B, 4724B, 1400. The 74C, 74HC, 74AC & 74ACT series are newer CMOS series.

Various series with TTL logic family are:-

Standard TTL 74.

Schottky TTL 74s.

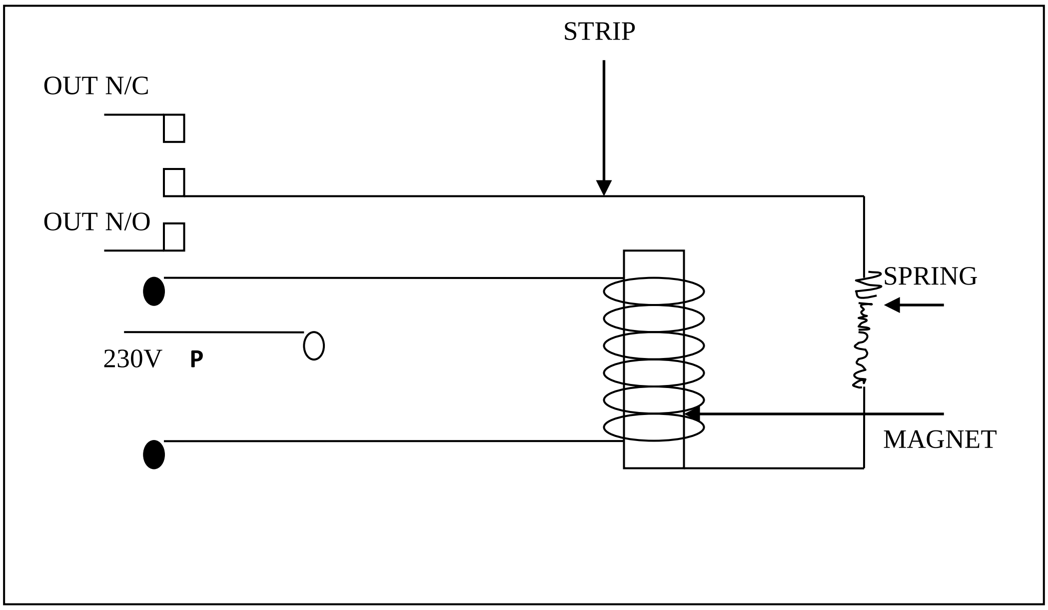
Low power Schottky 74LS.

Advance Schottky 74AS.

Advanced Low Power Schottky 74ALs.

Also there are various series with CMOS logic family as metal state CMOS 40 or 140.

RELAYS

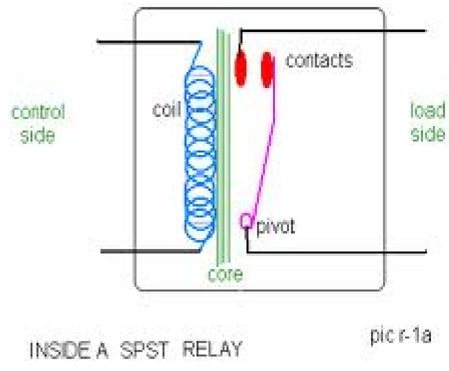


A relay is an electrically operated switch. The relay contacts can be made to operate in the pre-arranged fashion. For instance, normally open contacts close and normally closed contacts open. In electromagnetic relays, the contacts however complex they might be, they have only two position i.e. OPEN and CLOSED, whereas in case of electromagnetic switches, the contacts can have multiple positions.

USE OF RELAY

The reason behind using relay for switching loads is to provide complete electrical isolation. It means that there is no electrical connection between the driving circuits and the driven circuits. The driving circuit may be low voltage

operated low power circuits that control several kilowatts of power. In our circuit where a high fan could be switched on or off depending upon the output from the telephone.



Since the relay circuit operated on a low voltage, the controlling circuit is quite safe. In an electromagnetic relay the armature is pulled by a magnetic force only. There is no electrical connection between the coil of a relay and the switching contacts of the relay. If there are more than one contact they all are electrically isolated from each other by mounting them on insulating plates and washers. Hence they can be wired to control different circuits independently.

Some of the popular contacts forms are described below:

1. Electromagnetic relay
2. Power Relay.
3. Time Delay Relay.
4. Latching Relay.
5. Crystal Can Relay.
6. Co-axial Relay

1. Electromagnetic relay:

An electromagnetic relay in its simplest form consists of a coil, a DC current passing through which produces a magnetic field. This magnetic field attracts an armature, which in turn operates the contacts. Normally open contacts

close and normally closed contacts open. Electromagnetic relays are made in a large variety of contacts forms.

2. Power relays:

Power relays are multi-pole heavy duty lapper type relays that are capable of switching resistive loads of upto 25amp.. These relays are widely used for a variety of industrial application like control of fractional horse power motors, solenoids, heating elements and so on. These relays usually have button like silver alloy contacts and the contact welding due to heavy in rush current is avoided by wiping action of the contacts to quench the arc during high voltage DC switching thus avoiding the contact welding.

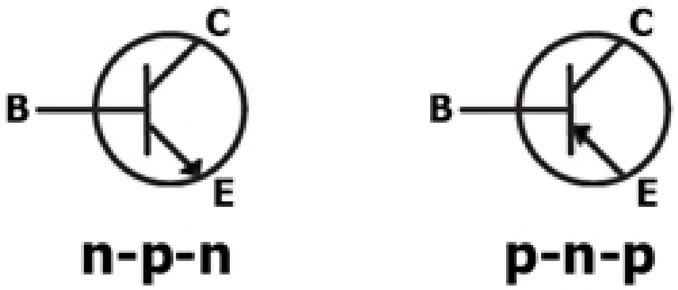
3. Time Delay Relay:

A time delay relay is the one in which there is a desired amount of time delay between the application of the actuating signal and operation of the load switching devices.

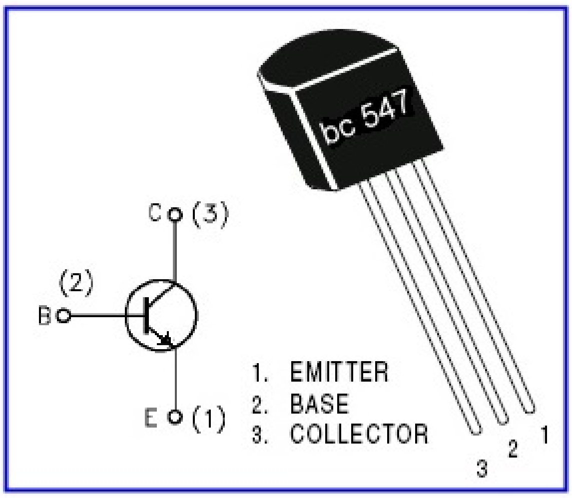
4. Latching Relay:

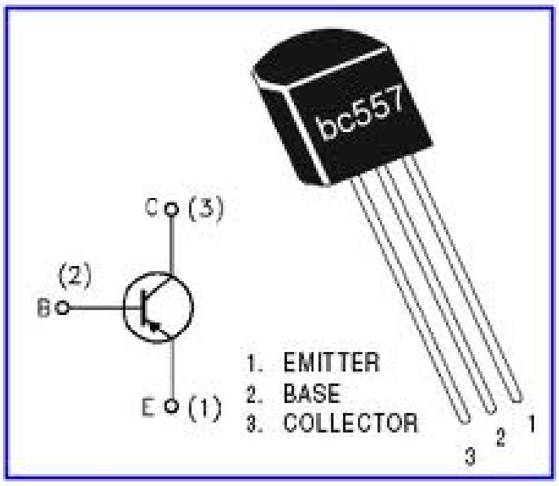
In a Latching Relay, the relay contacts remain in the last energized position even after removal of signal in the relay control circuit. The contacts are held in the last relay-energized position after removal of energisation either electrically or magnetically. The contacts can be released to the normal position electrically or mechanically.

Transistor:-



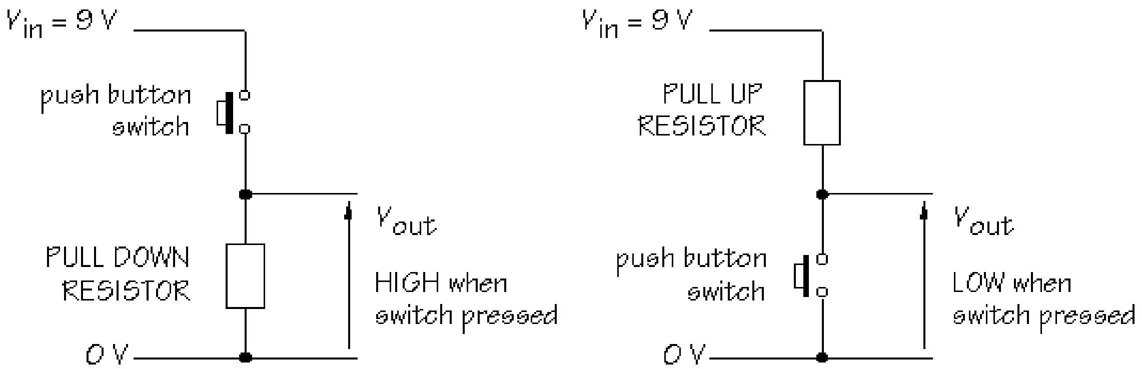
The schematic representation of a transistor is shown. Note the arrow pointing down towards the emitter. This signifies it's an NPN transistor A transistor is basically a current amplifier. Say we let 1mA flow into the base. We may get 100mA flowing into the collector. Note: The currents flowing into the base and collector exit through the emitter (sum off all currents entering or leaving a node must equal zero). The gain of the transistor will be listed in the datasheet as either β_{DC} or H_{fe}. The gain won't be identical even in transistors with the same part number. The gain also varies with the collector current and temperature.





Signals from switches

When a switch is used to provide an input to a circuit, pressing the switch usually generates a voltage signal. It is the voltage signal which triggers the circuit into action. What do you need to get the switch to generate a voltage



signal? . . . You need a voltage divider. The circuit can be built in either of two ways:

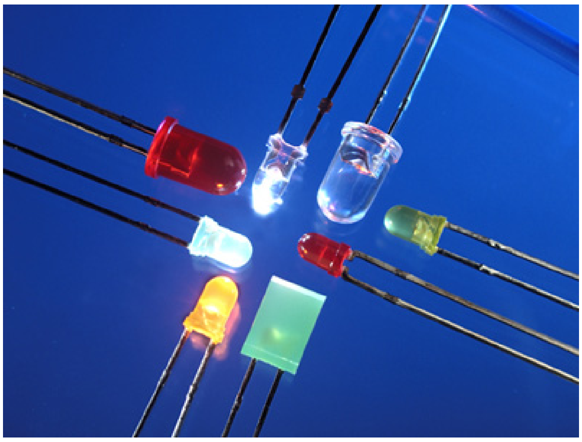
The **pull down resistor** in the first circuit forces V_{out} to become LOW except when the push button switch is operated. This circuit delivers a HIGH voltage when the switch is pressed. A resistor value of 10 kΩis often used.

In the second circuit, the **pull up resistor** forces V_{out} to become HIGH except when the switch is operated. Pressing the switch connects V_{out} directly to 0 V. In other words, this circuit delivers a LOW voltage when the switch is pressed.

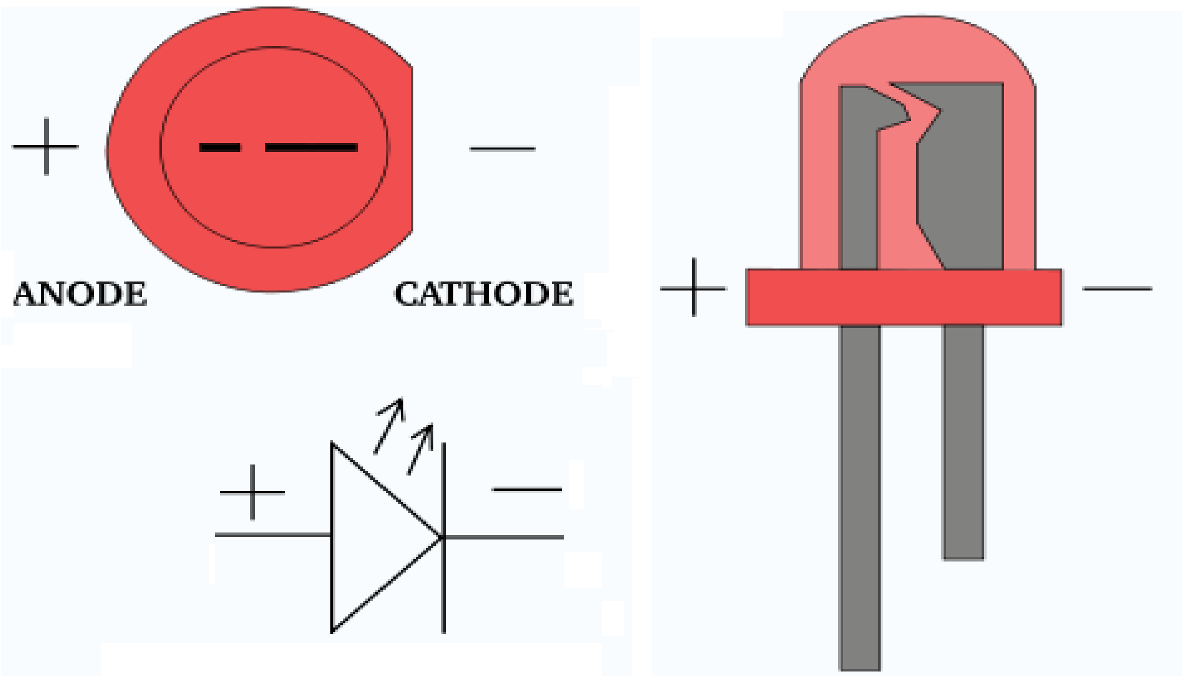
In circuits which process logic signals, a LOW voltage is called 'logic 0' or just '0', while a HIGH voltage is called 'logic1' or '1'. These voltage divider circuits are perfect for providing input signals for logic systems.

What kinds of switches could you use. One variety of push button switch is called a **miniature tactile switch**. These are small switches which work well with prototype board:

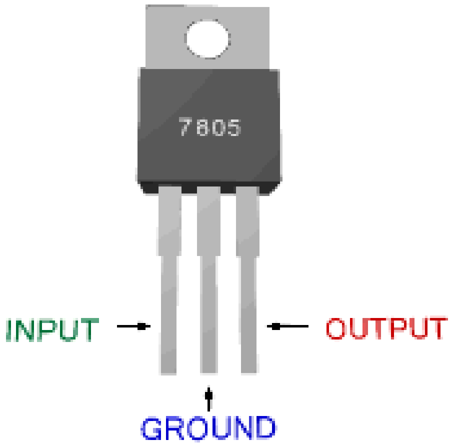
LED:- LED means light emitting diode. Its function is similar to the diode. But these are not made up from silicon or germanium. These are generally used as a indicating device. There are variety of LEDs are available in market depending upon their size and colour.



Polarity of LED:- LED have polarity. We can judge its polarity by watching flags in its structure. Bigger flag is known as cathode and smaller flag is known as anode as shown below.



Voltage Regulator The LM78XX 3-terminal positive voltage regulators employ internal current-limiting, thermal shutdown and safe-area



compensation, making them essentially indestructible. Heat sinking is provided; they can deliver over 1.0A output current. They are intended as fixed voltage regulators in a wide range of applications including local (on-card) regulation for elimination of noise and distribution problems associated with single-point regulation. In addition to use as fixed voltage regulators.

Features

■ Output current up to 1 A

■ Output voltages of 5; 6; 8; 9; 12; 15; 18; 24 V

■ Thermal overload protection

■ Short circuit protection

Crystal: -

It's a 2 terminal component. This component has no polarity. Its basic function to generate a Square Wave of some fixes frequency. Its value is measure in MHz.

MICROCONTROLLERS (MCU)

Figure shows the block diagram of a typical microcontroller, which is a true computer on a chip. The design incorporates all of the features found in micro-processor CPU, ALU, PC, SP, and registers. It also added the other features needed to make a complete computer: ROM, RAM, I/O,timer & counters,and clock circuit.

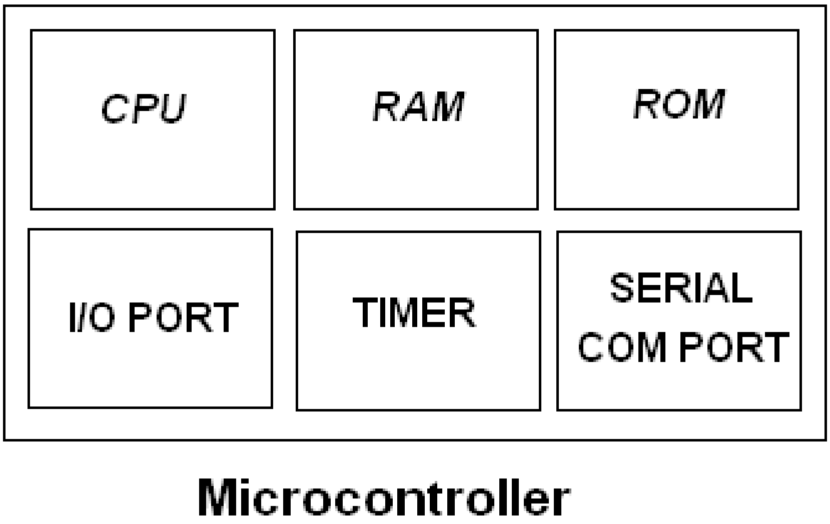


FIG 2:BLOCK DIAGRAM OF A MICROCONTROLLER

PIC16F8X MICROCONROLLER:

The PIC16F8X is a group in the PIC16CXX family of low-cost, high-performance, CMOS, fully-static, 8-bit microcontrollers. This group contains the following devices:

- PIC16F83
- PIC16F84
- PIC16CR83
- PIC16CR84

All PIC® microcontrollers employ an advanced RISC architecture. PIC16F8X devices have enhanced core features, eight-level deep stack, and multiple internal and external interrupt sources. The separate instruction and data buses of the Harvard architecture allow a 14-bit wide instruction word with a separate 8-bit wide data bus. The two stage instruction pipeline allows all instructions to execute in a single cycle, except for program branches (which require two cycles). A total of 35 instructions (reduced instruction set) are available. Additionally, a large register set is used to achieve a very high performance level. PIC16F8X microcontrollers typically achieve a 2:1 code compression and up to a 4:1 speed improvement (at 20 MHz) over other 8-bit microcontrollers in their class. The PIC16F8X has up to 68 bytes of RAM, 64 bytes of Data EEPROM memory, and 13 I/O pins. A timer/counter is also available.

The PIC16CXX family has special features to reduce external components, thus reducing cost, enhancing system reliability and reducing power consumption. There are four oscillator options, of which the single pin RC oscillator provides a low-cost solution, the LP oscillator minimizes power consumption, XT is a standard crystal, and the HS is for High Speed crystals. The SLEEP (power-down) mode offers power saving. The user can wake the chip from sleep through several external and internal interrupts and resets. A highly reliable Watchdog Timer with its own on-chip RC oscillator provides protection against software lockup. The devices with Flash program memory allow the same device package to be used for prototyping and production. In-circuit re-programmability allows the code to be updated without the device being removed from the end application. This is useful in the development of many applications where the device may not be easily accessible, but the prototypes may require code updates. This is also useful for remote applications where the code may need to be updated.

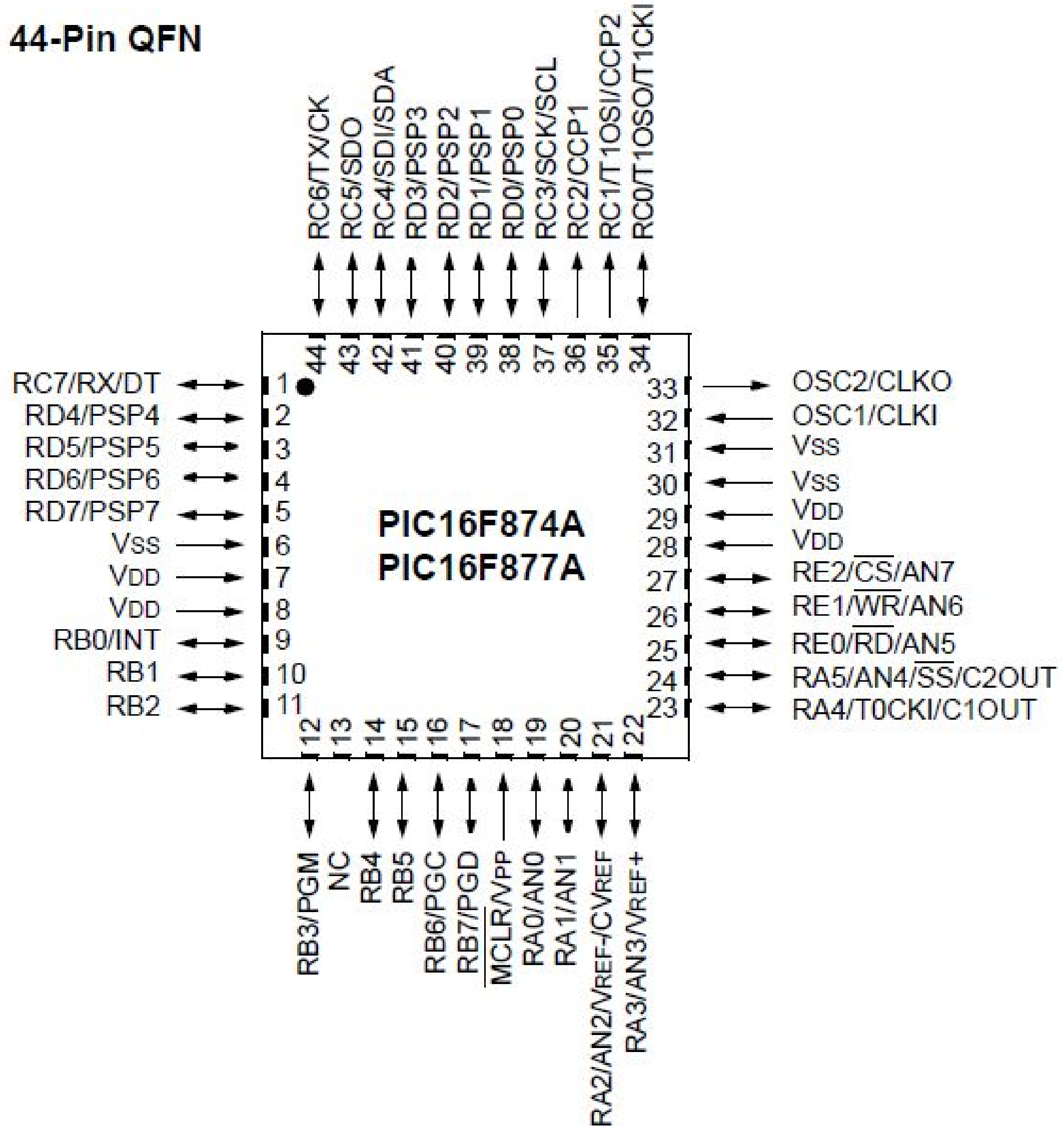
Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) - via two pins (ROM devices support only Data EEPROM programming)
- Power-up Timer (PWRT)
- Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Code-protection

• Power saving SLEEP mode
• Selectable oscillator options

CMOS Flash/EEPROM Technology:

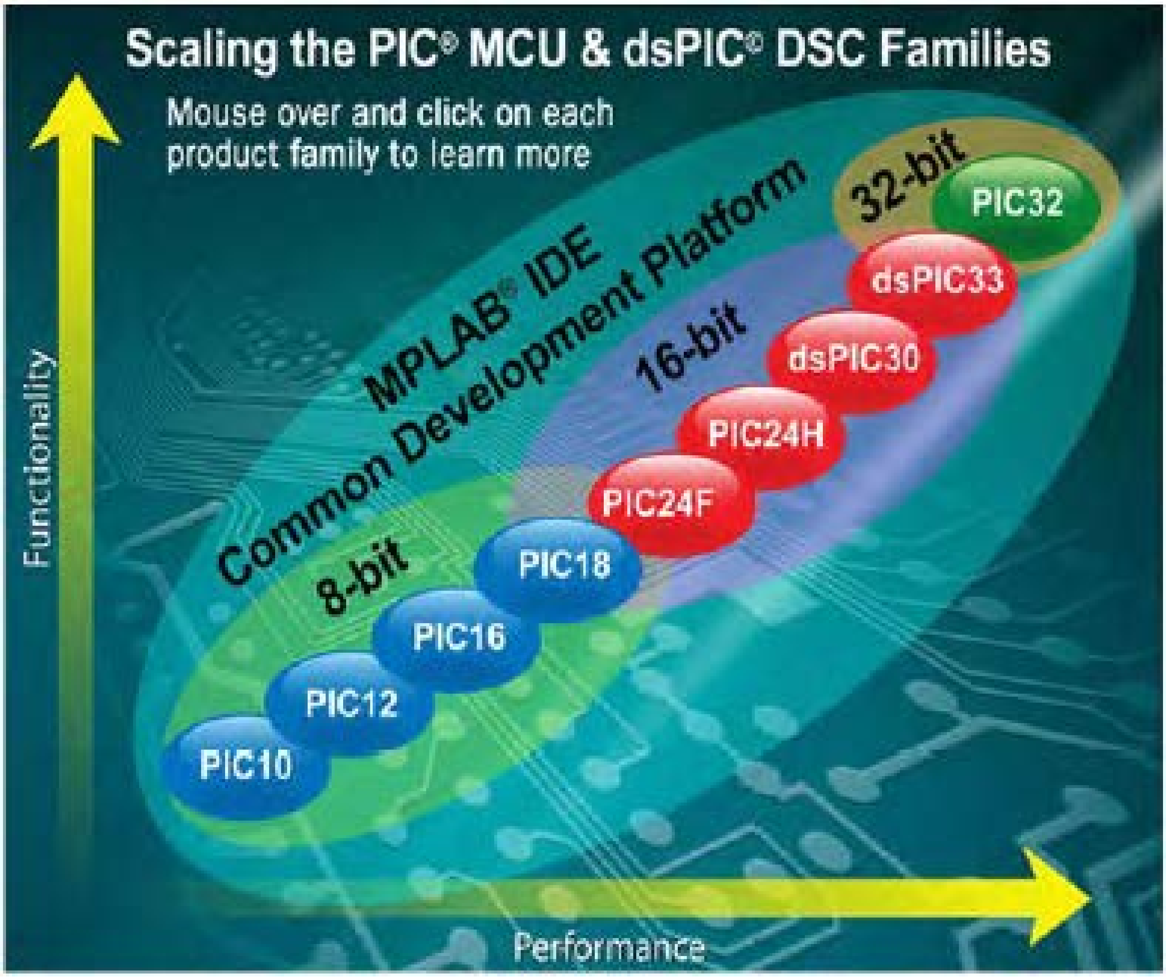
• Low-power, high-speed technology
• Fully static design
• Wide operating voltage range:
  - Commercial: 2.0V to 6.0V
  - Industrial: 2.0V to 6.0V

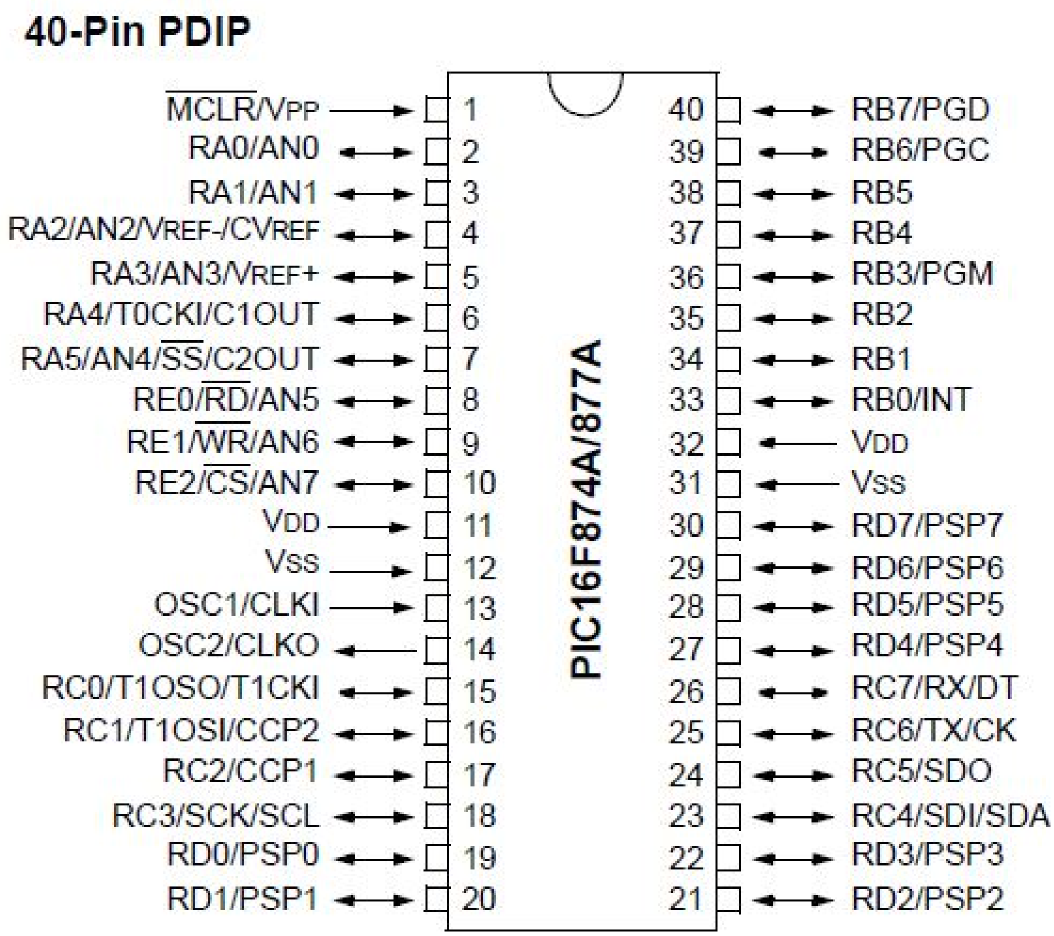


Chapter 5
PIC Microcontroller

(PIC 16F877A)

The Technology of Any Project is considered as The Heart as well as The Mind to It. The Biggest Concern to Any Student or Trainee Remains That the Technology He's gowning to Learn Must Be Up-to-Date and Must to be In Industry's Interest. So, that's Why we choose PIC Series of Microcontrollers. They are Cost Effective, Provide Wide Availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.





Special Features Of PIC 16F877A:

- 100,000 erase/write cycle Enhanced Flash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug (ICD) via two pins

Analog Features:

- 10-bit, up to 8-channel Analog-to-Digital
Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module with:
- Two analog comparators

- Programmable on-chip voltage reference
(VREF) module
- Programmable input multiplexing from device
inputs and internal voltage reference
- Comparator outputs are externally accessible

Data space (RAM)

PICs have a set of registers that function as general purpose RAM. Special purpose control registers for on-chip hardware resources are also mapped into the data space. The addressability of memory varies depending on device series, and all PIC devices have some banking mechanism to extend addressing to additional memory. Later series of devices feature move instructions which can cover the whole addressable space, independent of the selected bank. In earlier devices, any register move had to be achieved via the accumulator.

To implement indirect addressing, a "file select register" (FSR) and "indirect register" (INDF) are used. A register number is written to the FSR, after which reads from or writes to INDF will actually be to or from the register pointed to by FSR. Later devices extended this concept with post- and pre-increment/decrement for greater efficiency in accessing sequentially stored data. This also allows FSR to be treated almost like a stack pointer (SP).

External data memory is not directly addressable except in some high pin count PIC18 devices.

Code space

The code space is generally implemented as ROM, EPROM or flash ROM. In general, external code memory is not directly addressable due to the lack of an external memory interface. The exceptions are PIC17 and select high pin count PIC18 devices.

Word size

All PICs handle (and address) data in 8-bit chunks. However, the unit of addressability of the code space is not generally the same as the data space. For example, PICs in the baseline (PIC12) and mid-range (PIC16) families have program memory addressable in the same word size as the instruction width, i.e. 12 or 14 bits respectively. In contrast, in the PIC18 series, the program memory is addressed in 8-bit increments (bytes), which differs from the instruction width of 16 bits.

In order to be clear, the program memory capacity is usually stated in number of (single word) instructions, rather than in bytes.

Stacks

PICs have a hardware call stack, which is used to save return addresses. The hardware stack is not software accessible on earlier devices, but this changed with the 18 series devices.

Hardware support for a general purpose parameter stack was lacking in early series, but this greatly improved in the 18 series, making the 18 series architecture more friendly to high level language compilers.

Instruction set

A PIC's instructions vary from about 35 instructions for the low-end PICs to over 80 instructions for the high-end PICs. The instruction set includes instructions to perform a variety of operations on registers directly, the accumulator and a literal constant or the accumulator and a register, as well as for conditional execution, and program branching.

Some operations, such as bit setting and testing, can be performed on any numbered register, but bi-operand arithmetic operations always involve W (the accumulator), writing the result back to either W or the other operand register. To load a constant, it is necessary to load it into W before it can be moved into another register. On the older cores, all register moves needed to pass through W, but this changed on the "high end" cores.

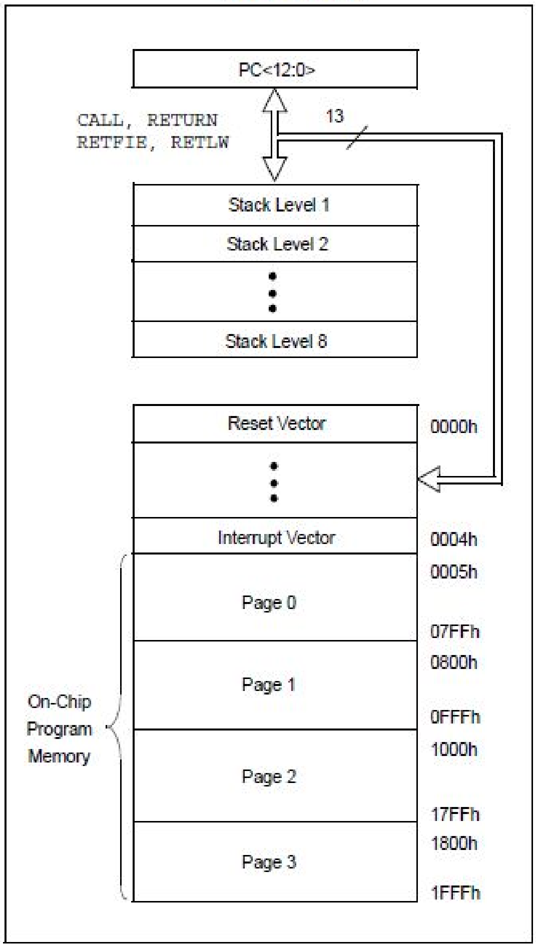
PIC cores have skip instructions which are used for conditional execution and branching. The skip instructions are 'skip if bit set' and 'skip if bit not set'. Because cores before PIC18 had only unconditional branch instructions, conditional jumps are implemented by a conditional skip (with the opposite condition) followed by an unconditional branch. Skips are also of utility for conditional execution of any immediate single following instruction. It is possible to skip instructions. For example, the instruction sequence "skip if A; skip if B; C" will execute C if A is true or if B is false.

The 18 series implemented shadow registers which save several important registers during an interrupt, providing hardware support for automatically saving processor state when servicing interrupts.

ARCHITECTURAL OVERVIEW

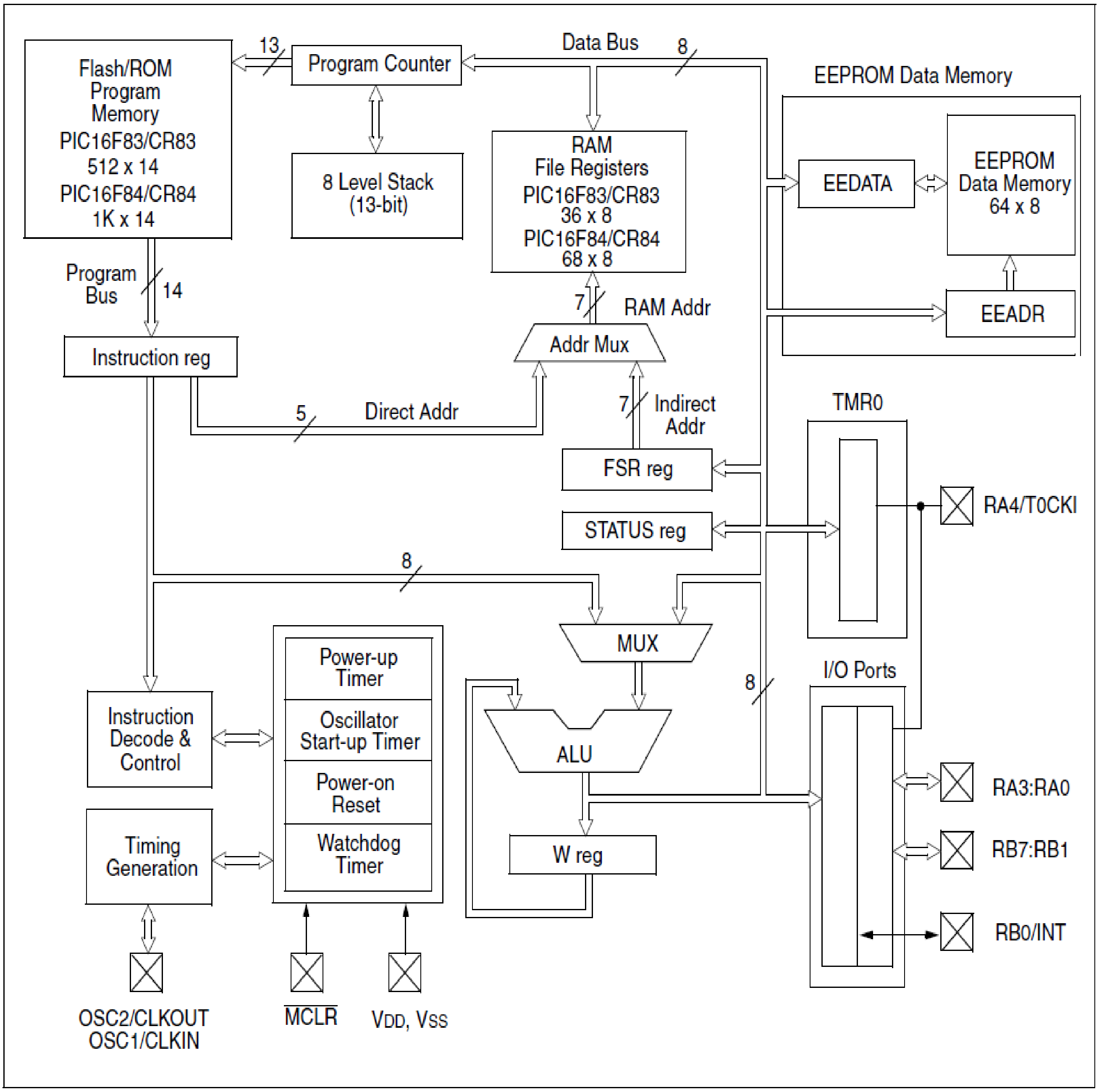
The high performance of the PIC16CXX family can be attributed to a number of architectural features commonly found in RISC microprocessors. To begin with, the PIC16CXX uses a Harvard architecture. This architecture has the program and data accessed from separate memories. So the device has a program memory bus and a data memory bus. This improves bandwidth over traditional von Neumann architecture where program and data are fetched from the same memory (accesses over the same bus). Separating program and data memory further allows instructions to be sized differently than the 8-bit wide data word. PIC16CXX opcodes are 14-bits wide, enabling single word instructions.

FIGURE 2-1: PIC16F876A/877A PROGRAM MEMORY MAP AND STACK



The full 14-bit wide program memory bus fetches a 14-bit instruction in a single cycle. A two stage pipeline overlaps fetch and execution of instructions (Example 3-1). Consequently, all instructions execute in a single cycle except for program branches. The PIC16F83 and PIC16CR83 address 512 x 14 of program memory, and the PIC16F84 and PIC16CR84 address 1K x 14 program memory. All program memory is internal. The PIC16CXX can directly or indirectly address its register files or data memory. All special function registers including the program counter are mapped in the data memory. An orthogonal (symmetrical) instruction set makes it possible to carry out any operation on any register using any addressing mode. This symmetrical nature and lack of 'special optimal situations' make programming with the PIC16CXX simple yet efficient. In addition, the learning curve is reduced significantly.

BLOCK DIAGRAM:



PIC16CXX devices contain an 8-bit ALU and working register. The ALU is a general purpose arithmetic unit. It performs arithmetic and Boolean functions between data in the working register and any register file. The ALU is 8-bits wide and capable of addition, subtraction, shift and logical operations. Unless otherwise mentioned, arithmetic operations are two's complement in nature. In two-operand instructions, typically one operand is the working register (W register), and the other operand is a file register or an immediate constant. In

single operand instructions, the operand is either the W register or a file register.

PINOUT DESCRIPTION:

Pin Name	DIP No.	SOIC No.	I/O/P Type	Buffer Type	Description
OSC1/CLKIN	16	16	I	ST/CMOS (3)	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	15	15	O	—	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, OSC2 pin outputs CLKOUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
$\overline{MCLR}$	4	4	I/P	ST	Master clear (reset) input/programming voltage input. This pin is an active low reset to the device.
					PORTA is a bi-directional I/O port.
RA0	17	17	I/O	TTL	
RA1	18	18	I/O	TTL	
RA2	1	1	I/O	TTL	
RA3	2	2	I/O	TTL	
RA4/T0CKI	3	3	I/O	ST	Can also be selected to be the clock input to the TMR0 timer/counter. Output is open drain type.
					PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.
RB0/INT	6	6	I/O	TTL/ST (1)	RB0/INT can also be selected as an external interrupt pin.
RB1	7	7	I/O	TTL	
RB2	8	8	I/O	TTL	
RB3	9	9	I/O	TTL	
RB4	10	10	I/O	TTL	Interrupt on change pin.
RB5	11	11	I/O	TTL	Interrupt on change pin.
RB6	12	12	I/O	TTL/ST (2)	Interrupt on change pin. Serial programming clock.
RB7	13	13	I/O	TTL/ST (2)	Interrupt on change pin. Serial programming data.
VSS	5	5	P	—	Ground reference for logic and I/O pins.
VDD	14	14	P	—	Positive supply for logic and I/O pins.

Legend: I= input O = output I/O = Input/Output P = power
— = Not used TTL = TTL input ST = Schmitt Trigger input

Why Use PIC MCU?

Supply voltage

Most microcontrollers operate with the standard logic voltage of 5V. Some microcontrollers can operate at as low as _2.7 V and some will tolerate _6 V without any problems. You should check the manufacturers' data sheets about the allowed limits of the power supply voltage. A voltage regulator circuit is usually used to obtain the required power supply voltage when the device is to be operated from a mains adaptor or batteries. For example, a 5 V regulator is required if the microcontroller is to be operated from a 5 V supply using a 9 V battery.

The Clock

All microcontrollers require a clock (or an oscillator) to operate. The clock is usually provided by connecting external timing devices to the microcontroller. Most microcontrollers will generate clock signals when a crystal and two small capacitors are connected. Some will operate with resonators or external resistor–capacitor pair. Some microcontrollers have built-in timing circuits and they do not require any external timing components. If your application is not time-sensitive you should use external or internal (if available) resistor–capacitor timing components for simplicity and low cost.

Timers

Timers are important parts of any microcontroller. A timer is basically a counter which is driven either from an external clock pulse or from the internal oscillator of the microcontroller. A timer can be 8-bits or 16-bits wide. Data can be loaded into a timer under program control and the timer can be stopped or started by program control. Most timers can be configured to generate an interrupt when they reach a certain count (usually when they overflow). The interrupt can be used by the user program to carry out accurate-timing-related operations inside the microcontroller. Some microcontrollers offer capture and compare facilities where a timer value can be read when an external event occurs, or the timer value can be compared to a preset value and an interrupt can be generated when this value is reached.

Watchdog

Most microcontrollers have at least one watchdog facility. The watchdog is basically a timer which is refreshed by the user program and a reset occurs if the program fails to refresh the watchdog. The watchdog timer is used to detect a system problem, such as the program being in an endless loop.
A watchdog is a safety feature that prevents runaway software and stops the microcontroller from executing meaningless and unwanted code. Watchdog facilities are commonly used in real-time systems where it is required to regularly check the successful termination of one or more activities.

Analogue-to-digital converter

An analogue-to-digital converter (A/D) is used to convert an analogue signal such as voltage to a digital form so that it can be read by a microcontroller. Some microcontrollers have built-in A/D converters. It is also possible to connect an external A/D converter to any type of microcontroller. A/D converters are usually 8-bits, having 256 quantisation levels. Some microcontrollers have 10-bit A/D converters with 1024 quantisation levels. Most PIC microcontrollers with A/D features have multiplexed A/D converters where more than one analogue input channel is provided.

Analogue Comparator

Analogue comparators are used where it is required to compare two analogue voltages. Although these circuits are implemented in most high-end PIC microcontrollers they are not common in other microcontrollers.

Real-time clock

Real-time clock enables a microcontroller to have absolute date and time information continuously. Built-in real-time clocks are not common in most microcontrollers since they can easily be implemented by either using a dedicated real-time clock chip, or by writing a program.

Sleep mode
Some microcontrollers (e.g. PIC) offer built-in sleep modes where executing this instruction puts the microcontroller into a mode where the internal oscillator is stopped and the power consumption is reduced to an extremely

low level. The main reason of using the sleep mode is to conserve the battery power when the microcontroller is not doing anything useful. The microcontroller usually wakes up from the sleep mode by external reset or by a watchdog time-out.

Power-on reset

Some microcontrollers (e.g. PIC) have built-in power-on reset circuits which keep the microcontroller in reset state until all the internal circuitry has been initialized. This feature is very useful as it starts the microcontroller from a known state on power-up. An external reset can also be provided where the microcontroller can be reset when an external button is pressed.

Low power operation

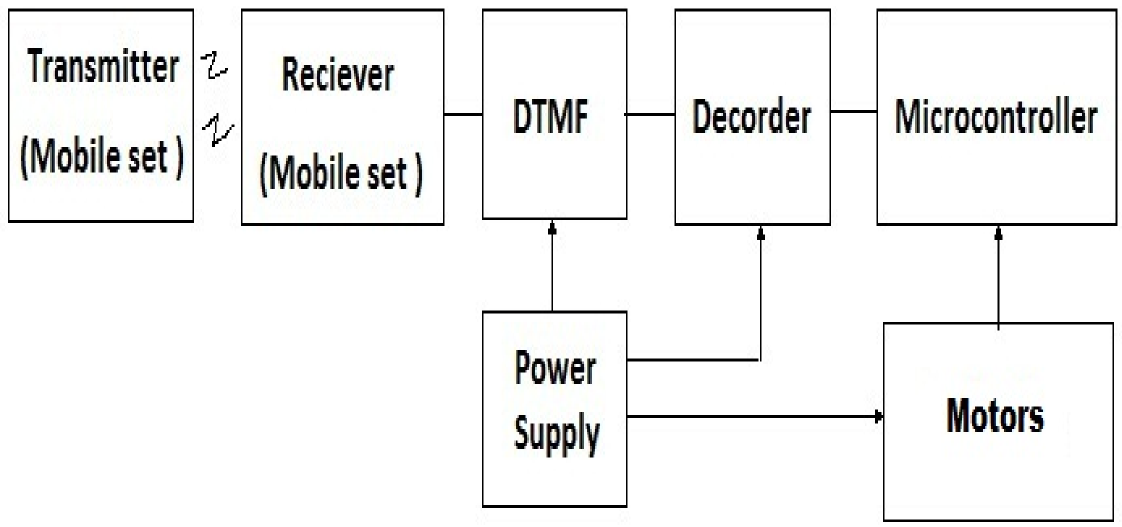
Low power operation is especially important in portable applications where the microcontroller based equipment is operated from batteries. Some microcontrollers (e.g. PIC) can operate with less than 2 mA with 5 V supply, and around 15_A at 3 V supply. Some other microcontrollers, especially microprocessor-based systems where there could be several chips may consume several hundred milli amperes or even more.

Current sink/source capability

This is important if the microcontroller is to be connected to an external device which may draw large current for its operation. PIC microcontrollers can source and sink 25 mA of current from each output port pin. This current is usually sufficient to drive LEDs, small lamps, buzzers, small relays, etc. The current capability can be increased by connecting external transistor switching Circuits or relays to the output port pins.

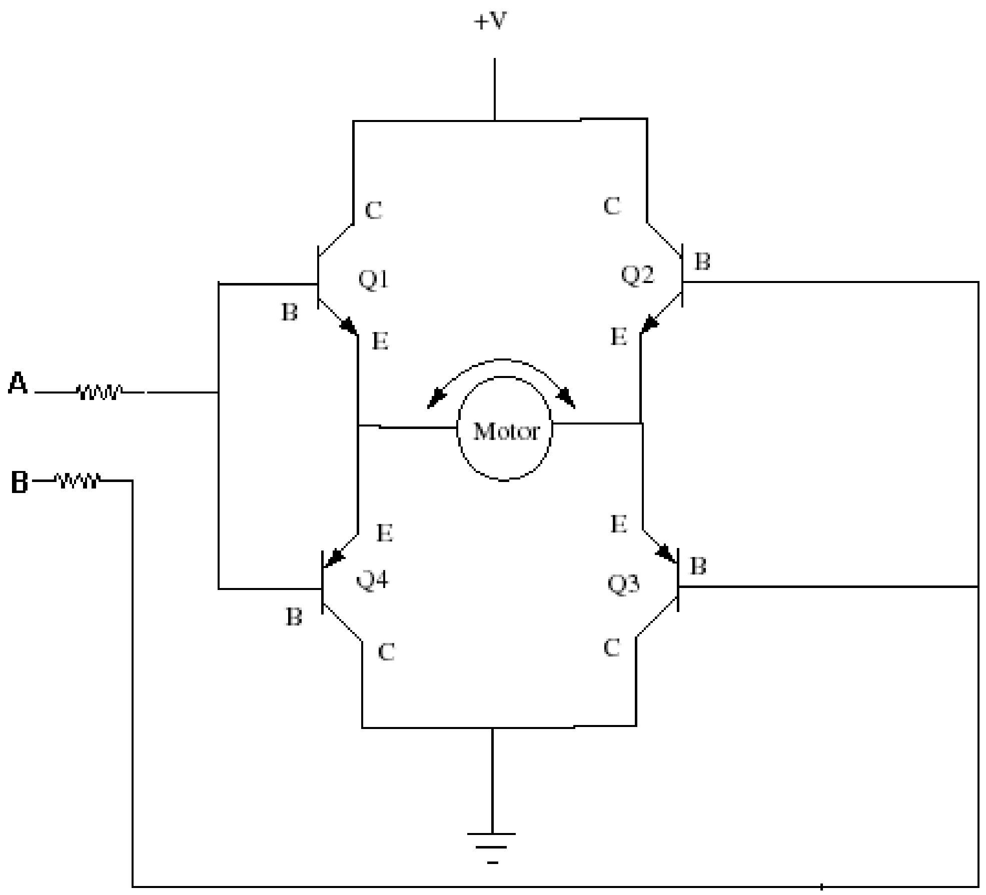
Chapter 6

Working of GSM Robot



Radio control (often abbreviated to R/C or simply RC) is the use of radio signals to remotely control device. The term is used frequently to refer to the control of model vehicles from a hand-held radio transmitter. Industrial, military, and scientific research organizations make use of radio-controlled vehicles as well. A remote control vehicle (RCV) is defined as any mobile device that is controlled by a means that does not restrict its motion with an origin external to the device. This is often a radio control device, cable between control and vehicle, or an infrared controller. A RCV is always controlled by a human and takes no positive action autonomously. One of the key technologies which underpin this field is that of remote vehicle control. It is vital that a vehicle should be capable of proceeding accurately to a target area manoeuvring within that area to fulfil its mission and returning equally accurately and safely to base. This project includes a robotic car consisting of a cell phone, DTMF decoder and microcontroller. The transmitter is a handheld mobile phone.

CIRCUIT DIAGRAM



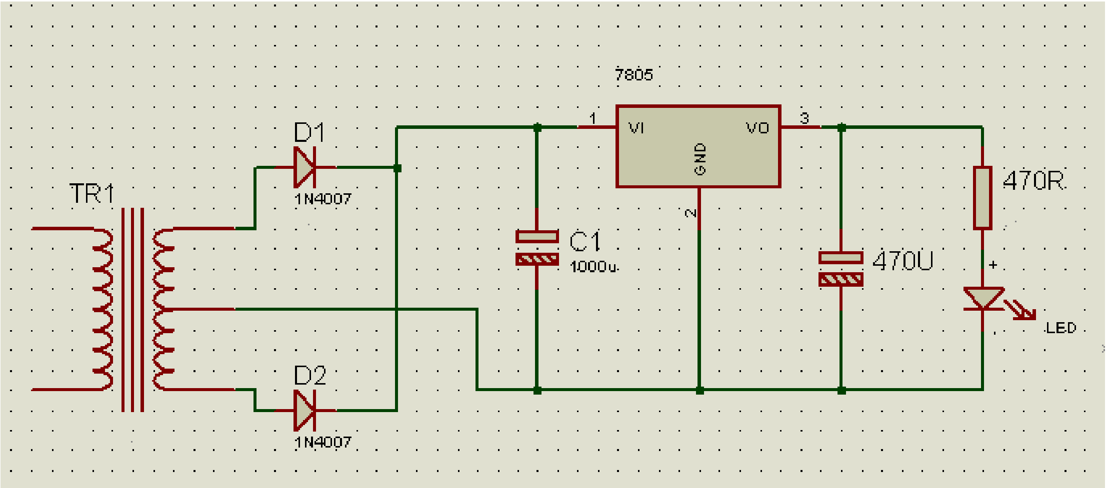
MATERIAL

1. Transformer (12V)
2. Diodes (IN4007)
3. Capacitor 470uF (1)
4. Capacitor 1000uf (1)
5. Capacitor .01uf (2)
6. Capacitor 27pf (2)
7. Voltage Regulator (7805 & 7812)
8. Resistors 4.7K (4)
9. Resistors 22K (2)
10. Resistors 100K (2)

11. Resistors 470R (6)
12. Resistors 1K (8)
13. Resistors 56K (2)
14. LED (5)
15. Microcontroller(AT89S52)
16. Crystal (12MHz)
17. Crystal (3.5792MHz)
18. DTMF 9170
19. Decoder 74154
20. 2 Mobile Handsets
21. Head phones
22. Relays 12V (4)
23. Sockets (4)
24. Transistors BC557(6)
25. Transistors BC547(6)
26. IC base (40 pin)
27. IC base (20 pin)
28. IC base (24 pin)
29. Ribbon wire (2 meter)
30. Jumper wire
31. PCB
32. Soldering Iron
33. Soldering Wire
34. Multimeter
35. Cutter
36. Screw & Nuts

When microcontroller is powered up then due to the reset circuit microcontroller goes reset and go to first location of ROM. We have written the program from the very first location of ROM. After the microcontroller goes reset it start executing instruction from 00h to the end of program. All the instructions are executed sequentially. Crystal circuit is providing clock frequency to the microcontroller

Power supply: - Power supply is the essential part of any device or project. We are using microcontroller and LED. These components needs +5V DC supply. So we need a power supply circuit of +5V DC. Power supply circuit includes step down transformer, rectifier circuit, filter circuit and regulator circuit. An indicating component is also attached with the power supply to indicate the power ON condition of power supply unit.



A step down transformer of 12-0-12 V and 750 mA is used to step down the AC power supply. This transformer can provide current up to 750 mA. Our circuit load is below 750 mA. So there will not be any loading effect on transformer. Output of transformer is given to the rectifier circuit. We are using a central tapped full wave rectifier. In this rectifier we are using 1N4007 pn diode to rectify AC voltage. Output of this rectifier is not purely DC. Output of rectifier is rippled DC. So we need some filtering section to rectify this ripples. Output voltage of rectifier can be calculated by :-

Vout = (Vin * √2)- (Forward voltage drop of diode)

1N4007 is a silicon semiconductor material based diode. So in this case forward Voltage drop is .7 V. Final output of this rectifier be:-

Vout= (12*√2)- .7

Vout= 16.1 V

Rectifier circuit is build of capacitor. A capacitor of 1000uF,25V is used to filter the ripples. Output of capacitor is almost pure DC. But its voltage is 16V and we need +5V DC. So we are using a voltage regulator to get the desired +5V DC. A 7805 voltage regulator is a suitable component for this purpose. Output of 7805 regulator is +5V DC. A capacitor of 470uf, 10V is used to further filter out the critical ripples. A LED is used as an indicating device. Most of LED operates at 1.5 to 2.5V voltage range with 8-10 mA. LED used here is of 5mm size. We consider that LED operating at 1.6V with 8mA current. We can calculate the value of resistor using the KVC law.

Total Voltage= Voltage across resistor + Voltage across LED

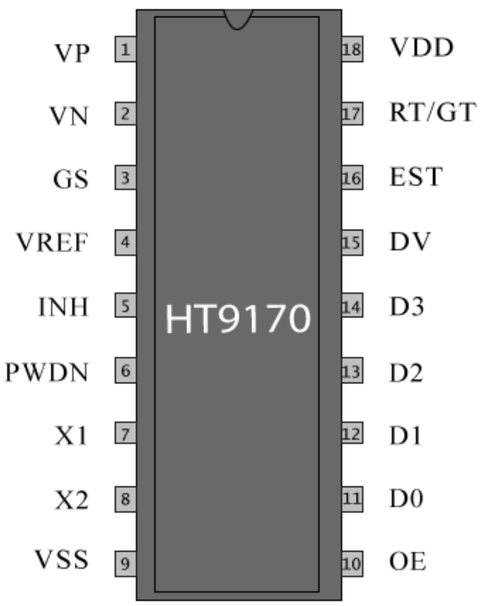
LED and resistor are connected in series so same current will flow. Means 8mA current will flow through the resistor.

Now Total Voltage is =5V
Voltage across resistor is =1.6v
Current is = 8mV
So our equation will be
5V= (10mA * resistance) + 1.6V
3.4V=10mA * resistance
Resistance =3.4/10mA
= 450 ohm

Thus we can calculate the any series resistor for any input voltage and LED.

DTMF

Today, most telephone equipment use a DTMF receiver IC. One common DTMF receiver IC is the HT9170 that is widely used in electronic communications circuits. The HT9170 is an 18-pin IC. It is used in telephones and a variety of other applications. When a proper output is not obtained in projects using this IC, engineers or technicians need to test this IC separately. A quick testing of this IC could save a lot of time in research labs and manufacturing industries of communication instruments.



The HT9170 series are Dual Tone Multi Frequency (DTMF) receivers integrated with digital decoder and band split filter functions. The HT9170B and HT9170D types supply power-down mode and inhibit mode operations. All types of the HT9170 series use digital counting techniques to detect and decode all the 16 DTMF tone pairs into a 4-bit code output. Highly accurate switched capacitor filters are employed to divide tone (DTMF) signals into low and high group signals. A built-in dial tone rejection circuit is provided to eliminate the need for pre-filtering.

VP: - Operational amplifier non-inverting input

VN:- Operational amplifier inverting input

GS: - Operational amplifier output terminal

VREF:-VREF Reference voltage output, normally VDD/2

X1, X2:-The system oscillator consists of an inverter, a bias resistor and the Necessary load capacitor on chip. A standard 3.579545MHz crystal connected to X1 and X2 terminals implements the oscillator function.

PWDN:- Active high. This enables the device to go into power down mode and inhibits the oscillator. This pin input is internally pulled down.

INH :- Logic high. This inhibits the detection of tones representing characters A, B, C and D. This pin input is internally pulled down.

VSS :-Negative power supply

OE :- output enable, high active

D0~D3 :- Receiving data output terminals

OE:-Output enable

OE:-High impedance

DV :- Data valid output When the chip receives a valid tone (DTMF) signal, the DV goes high; otherwise it remains low.

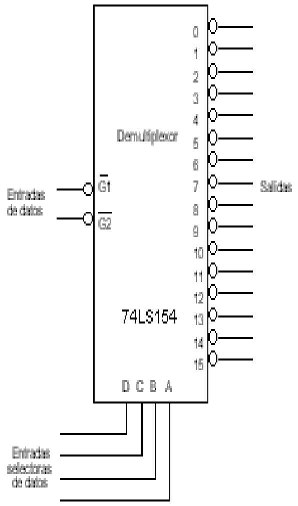
EST :- Early steering output

RT/GT I/O CMOS IN/OUT:- Tone acquisition time and release time can be set through connection with external resistor and capacitor.

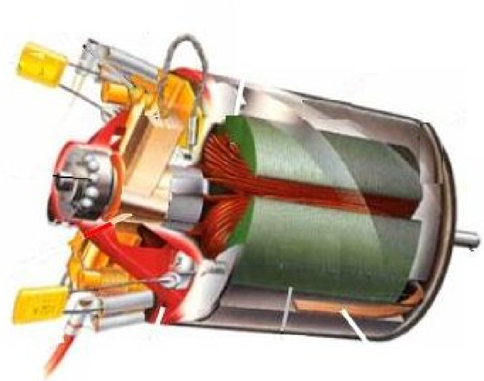
VDD :-Positive power supply, 2.5V~5.5V for normal operation

4 TO 16 DECODER

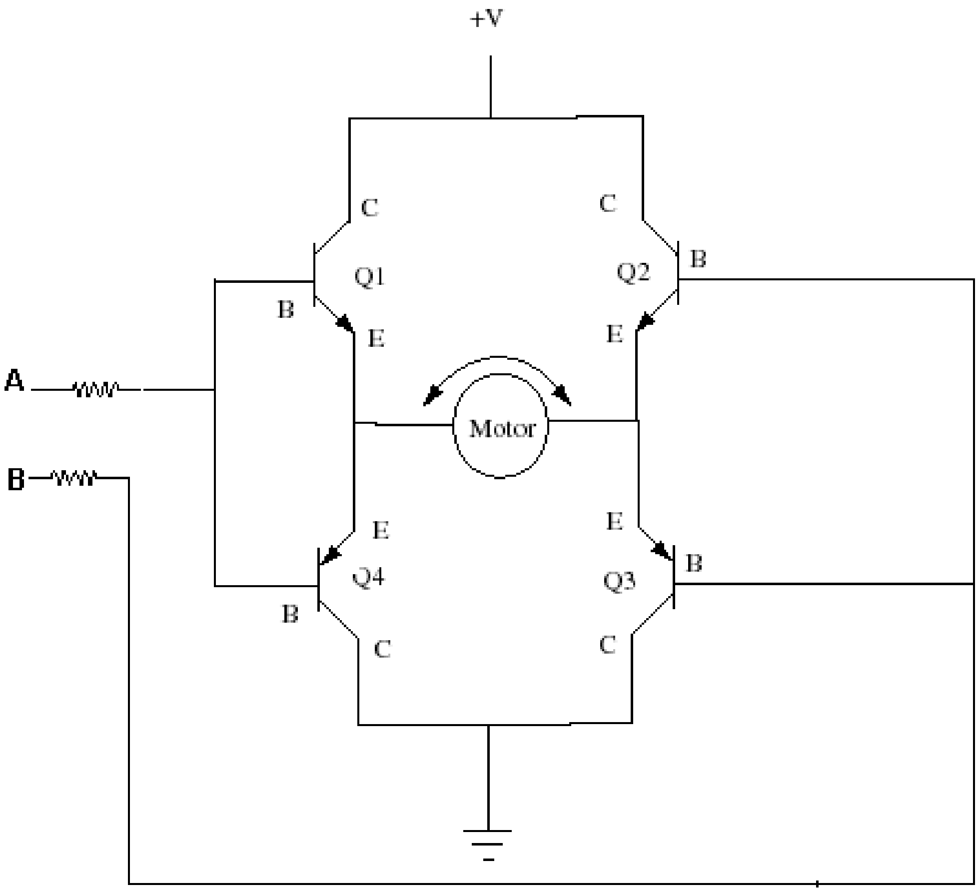
The 74HC/HCT154 decoders accept four active HIGH binary address inputs and provide 16 mutually exclusive active LOW outputs. The 2-input enable gate can be used to strobe the decoder to eliminate the normal decoding “glitches” on the outputs, or it can be used for the expansion of the decoder. The enable gate has two AND’ed inputs which must be LOW to enable the outputs. The “154” can be used as a 1-to-16 demultiplexer by using one of the enable inputs as the multiplexed data input. When the other enable is LOW, the addressed output will follow the state of the applied data.



DC MOTOR

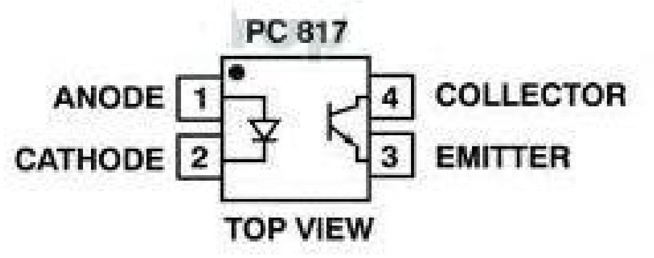


PRINCIPLE OF OPERATION



An isolator device to electrically insulate and isolate a separate component in a circuit board arrangement to allow for relatively fast and convenient diagnostic inspection of a circuit to locate failed components

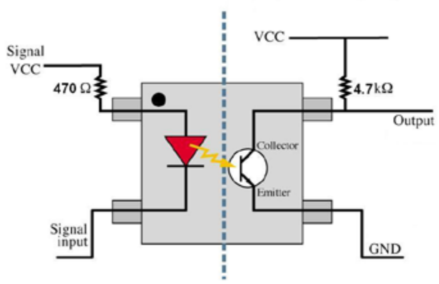
In electronics, an opto-isolator, also called an optocoupler, photocoupler, or optical isolator, is "an electronic device designed to transfer electrical signals by utilizing light waves to provide coupling with electrical isolation between its input and output. The main purpose of an opto-isolator is "to prevent high voltages or rapidly changing voltages on one side of the circuit from damaging components or distorting transmissions on the other side



An opto-isolator contains a source (emitter) of light, almost always a near infrared light-emitting diode (LED), that converts electrical input signal into light, a closed optical channel (also called dielectrical channel), and a photosensor, which detects incoming light and either generates electric energy directly, or modulates electric current flowing from an external power supply. The sensor can be a photoresistor, a photodiode, a phototransistor. Pin diagram of PC 817 is shown below.

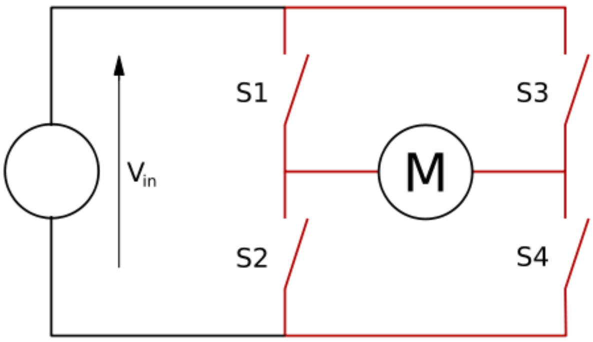
Working: - PC 817 is a 4 pin opto coupler as shown above. A series resistance of 470 ohm is used to limit the voltage across the diode. +5V power supply is connected to the first pin of IC, which is the anode pin diode. 2nd pin is connected to the port of microcontroller. When the second pin is low then we get low output, when the input to 2nd pin high we get high voltage the output. Thus we isolate the voltage having the same logic level.

H-BRIDGE CIRCUIT



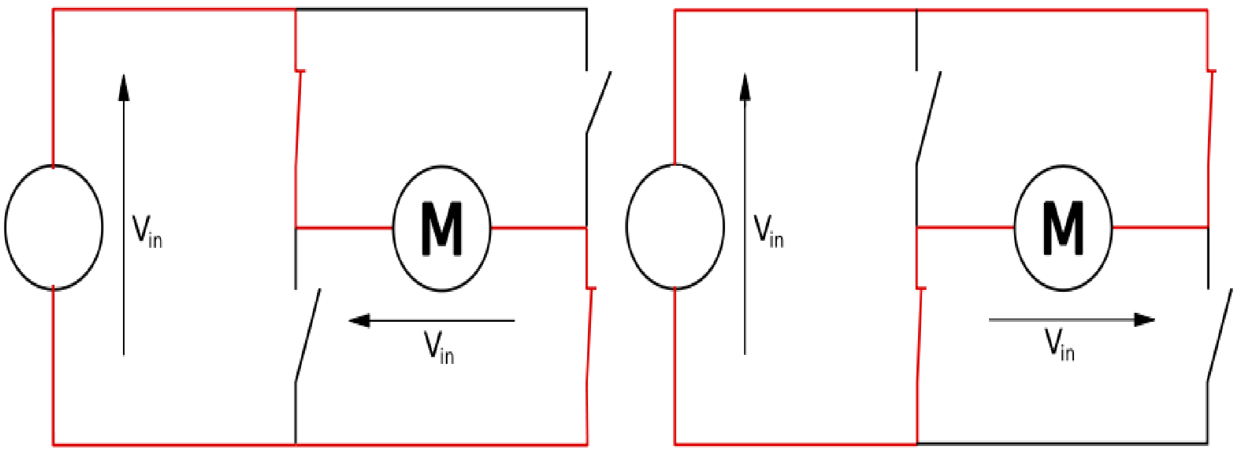
Working: - An H bridge is an electronic circuit which enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards.

The term *H bridge* is derived from the typical graphical representation of such a circuit. An H bridge is built with four switches (solid-state or mechanical).



When the switches S1 and S4 are closed (and S2 and S3 are open) a positive voltage will be applied across the motor. By opening S1 and S4 switches and closing S2 and S3 switches, this voltage is reversed, allowing reverse operation of the motor.

Using the nomenclature above, the switches S1 and S2 should never be closed at the same time, as this would cause a short circuit on the input voltage source. The same applies to the switches S3 and S4. This condition is known as shoot-through.



The two basic states of an H bridge

The H-bridge arrangement is generally used to reverse the polarity of the motor, but can also be used to 'brake' the motor, where the motor comes to a sudden stop, as the motor's terminals are shorted, or to let the motor 'free run' to a stop, as the motor is effectively disconnected from the circuit.

Chapter 7

Applications Of GSM Based Robotic Vehicle:

Scientific Use

Remote control vehicles have various scientific uses including hazardous environments. Majority of the probes to the other planets in our solar system have been remote control vehicles, although some of the more recent ones were partially autonomous. The sophistication of these devices has fueled greater debate on the need for manned spaceflight and exploration. The Voyager I spacecraft is the first craft of any kind to leave the solar system. The Martian explorers Spirit and Opportunity have provided continuous data about the surface of Mars since January 3, 2004.

Military and Law Enforcement Use

Military usage of remotely controlled military vehicles dates back the first half of 20th century. Soviet Red Army used remotely controlled Tele tanks during 1930s in the Winter War and early stage of World War II. There were also remotely controlled cutters and experimental remotely controlled planes in the Red Army.

Remote control vehicles are used in law enforcement and military engagements for some of the same reasons. Exposure to hazards is mitigated to the person who operates the vehicle from a location of relative safety. Remote controlled vehicles are used by many police department bomb-squads to defuse or detonate explosives.

Unmanned Aerial Vehicles (UAVs) have undergone a dramatic evolution in capability in the past decade. Early UAV's were capable of reconnaissance missions alone and then only with a limited range. Current UAV's can hover

around possible targets until they are positively identified before releasing their payload of weaponry. Backpack sized UAV's will provide ground troops with over the horizon surveillance capabilities.

Search and Rescue

UAVs will likely play an increased role in search and rescue in the United States. Slowly other European countries (even some developing nations) are thinking about making use of these vehicles in case of natural calamities &emergencies. This can be a great asset to save lives of both people along with soldiers in case of terrorist attacks like the one happened in 26 Nov, 2008 in Mumbai, India. The loss of military personnel can be largely reduced by using these advanced methods. This was demonstrated by the successful use of UAVs during the 2008 hurricanes that struck Louisiana and Texas.

Forest Conservation

In the recent times, there has been a serious endangerment to the wildlife population. A lot of animals are on the verge of becoming extinct, including the tiger. The spy robotic car can aid us in this purpose. Since it is a live streaming device and also mobile, it can keep the forest guards constantly updated about the status of different areas which are prone to attack. As a result, it can help to prevent further destruction of the forest resources by enabling correct prohibitory action at the appropriate time.

FUTURE SCOPE :

IR Sensors

IR sensors can be used to automatically detect & avoid obstacles if the robot goes beyond line of sight. This avoids damage to the vehicle if we are maneuvering it from a distant place.

Password Protection

Project can be modified in order to password protect the robot so that it can be operated only if correct password is entered. Either cell phone should be password protected or necessary modification should be made in the assembly language code. This introduces conditioned access and increases security to a great extent.

Alarm Phone Dialler

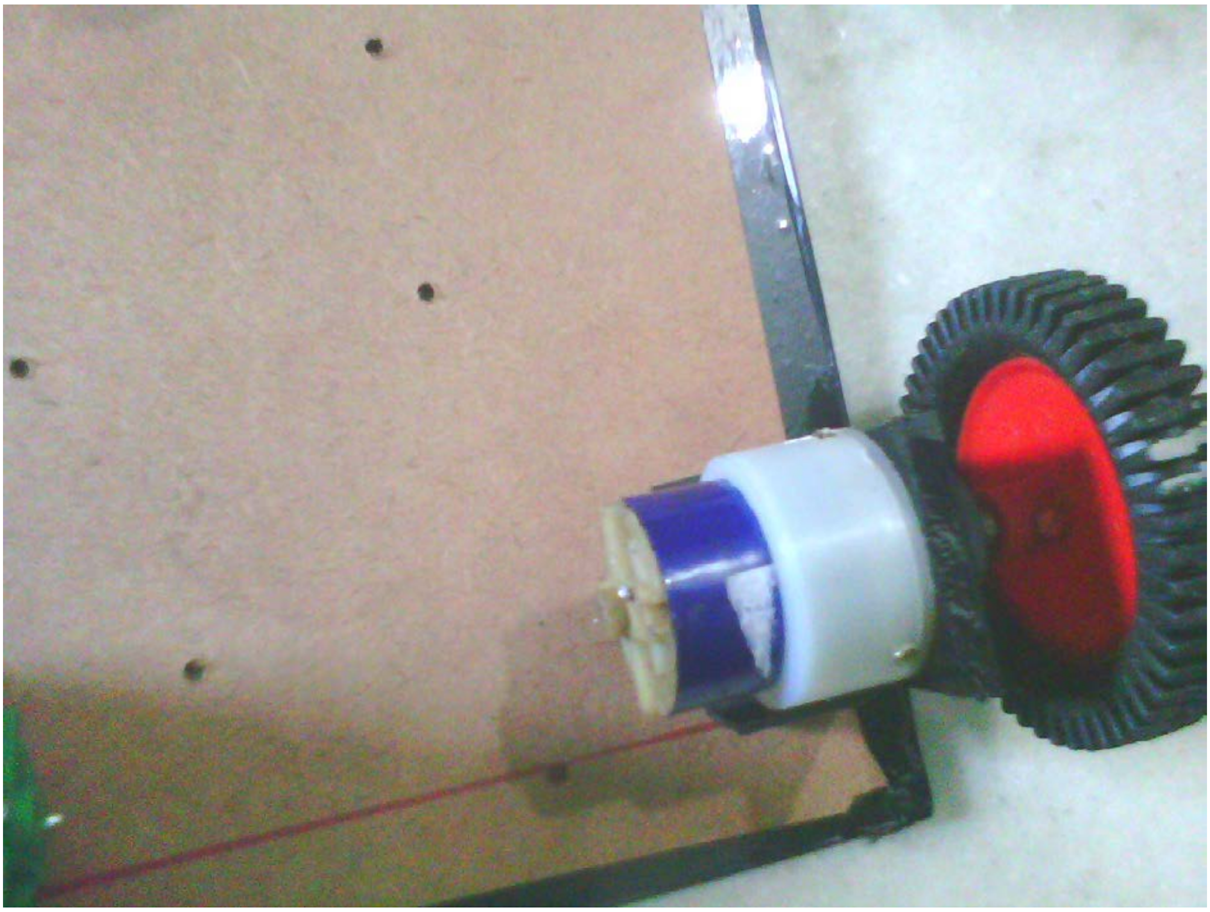
By replacing DTMF Decoder IC CM8870 by a 'DTMF Transceiver IC CM8880, DTMF tones can be generated from the robot. So, a project called 'Alarm Phone Dialer' can be built which will generate necessary alarms for something that is desired to be monitored (usually by triggering a relay). For example, a high water alarm, low temperature alarm, opening of back window, garage door, etc. When the system is activated it will call a number of programmed numbers to let the user know the alarm has been activated. This would be great to get alerts of alarm conditions from home when user is at work.

Bonus Section #1

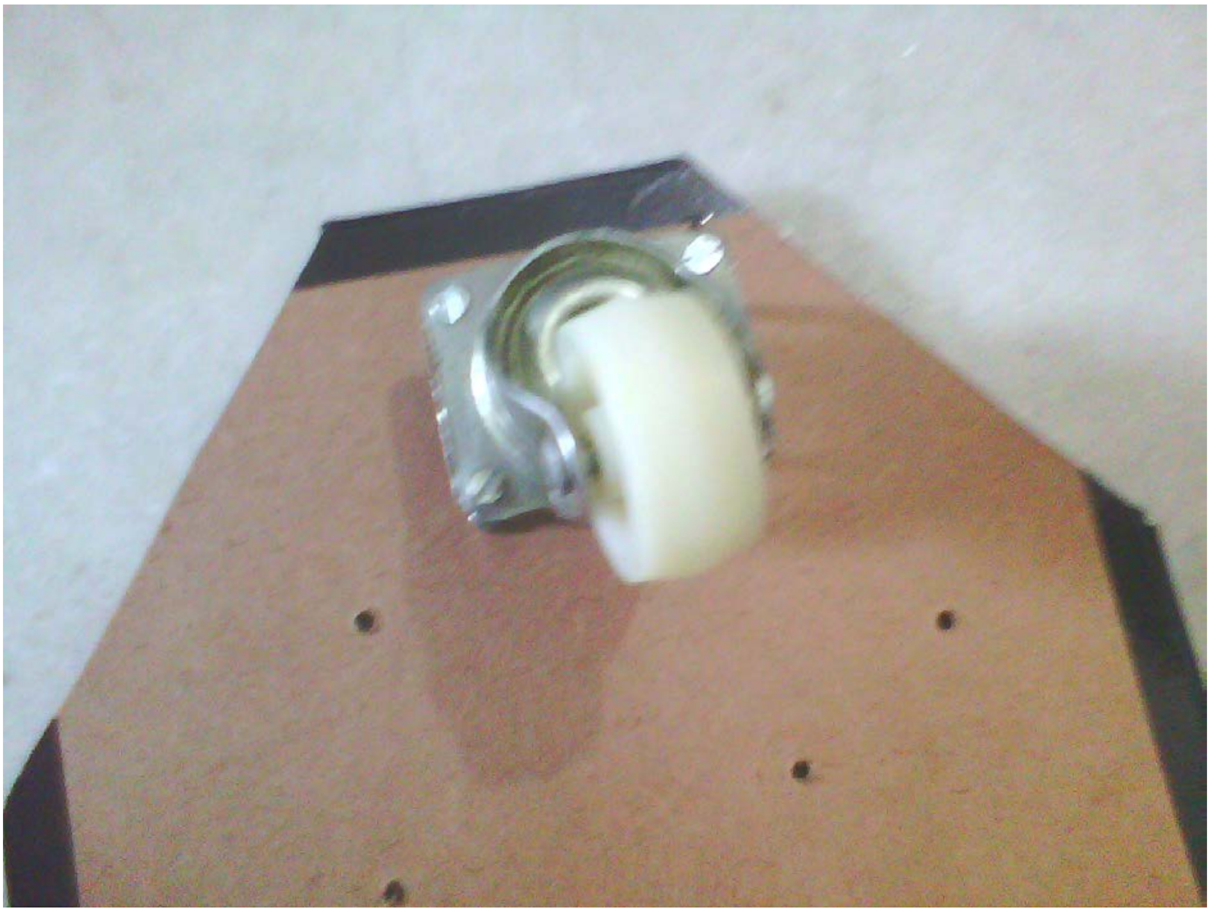
Actual Photographs Of Project:

The Base of Robotic Vehicle (With Legs Supporters)

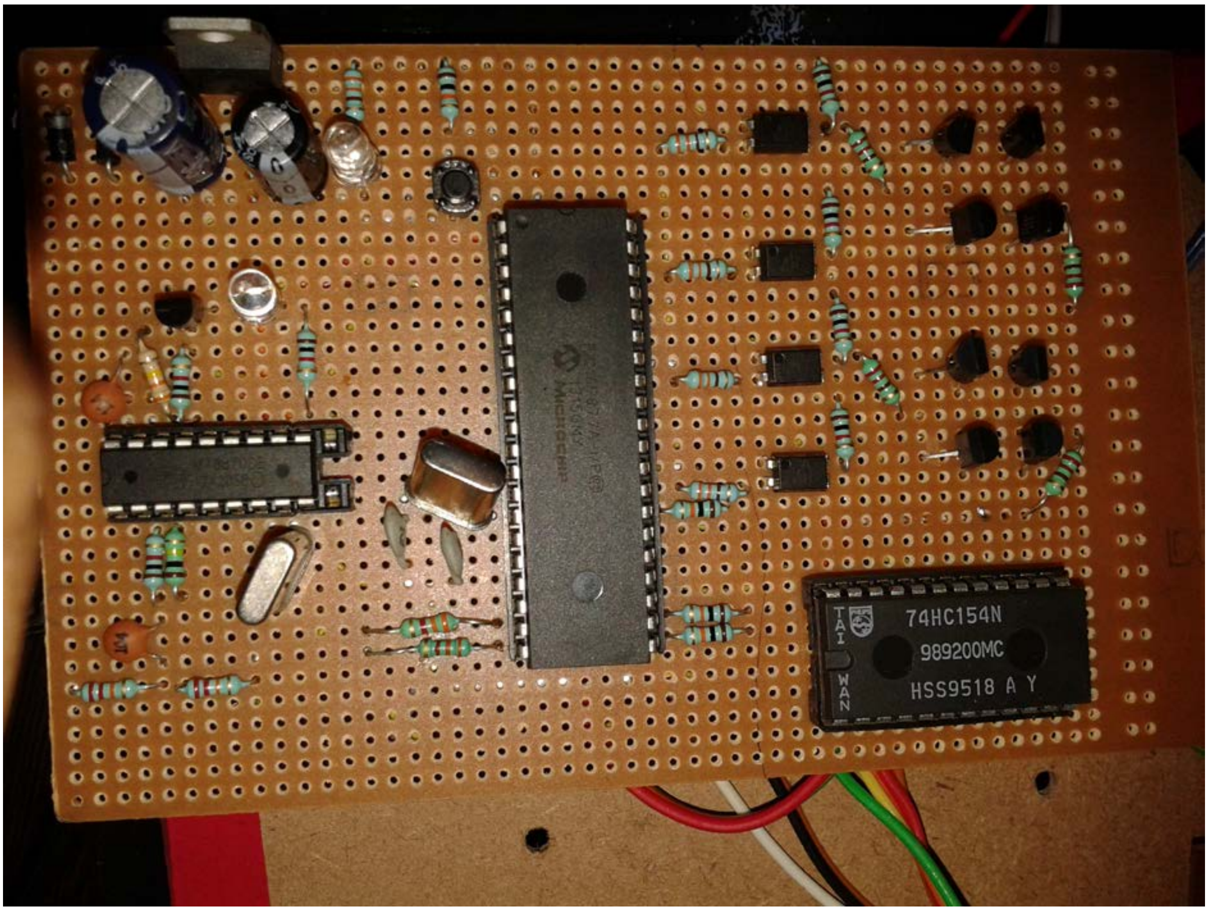
Installed Leg for Base of Vehicle



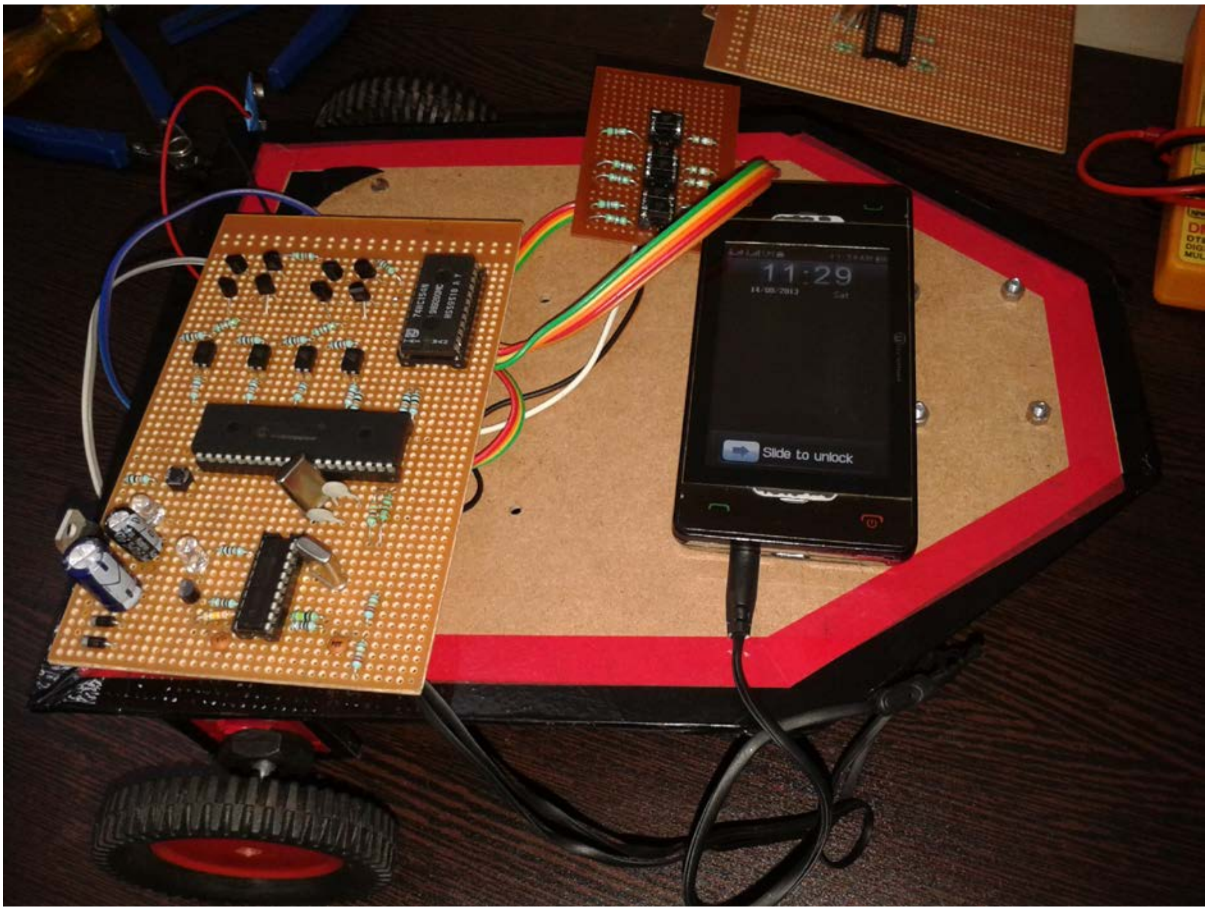
Wheel Installed With DC Motor on Leg



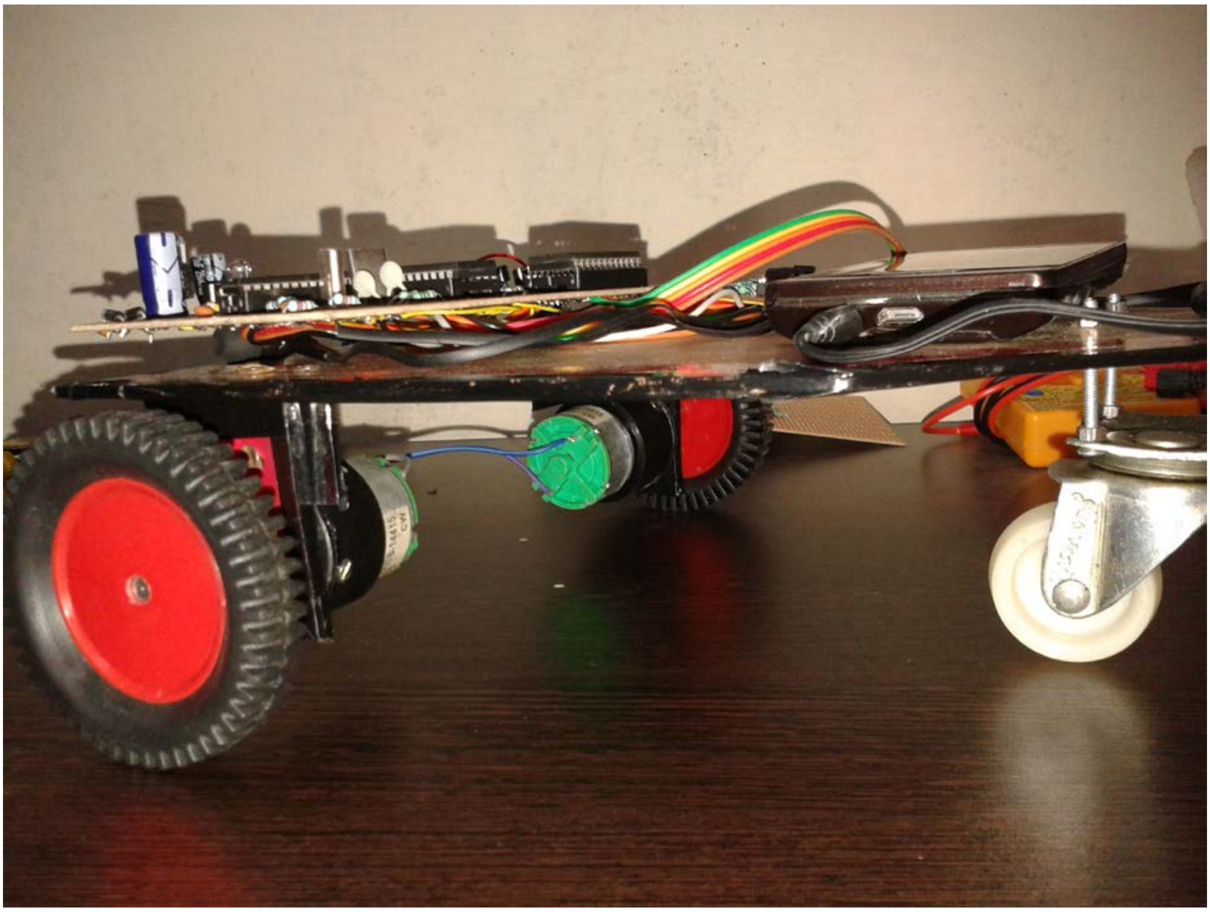
Front Wheel to give additional support while running



Actual PCB with installed components Of GSM based robotic vehicle



GSM Based Robotic Project in finalising Stage



Complete GSM based versatile robotics vehicle

Bonus Section #2

Appendix:

Abstraction allows us to layer semantics of complex system, breaking them into more manageable pieces.

Robot: A machine capable of carrying out a complex series of actions automatically, esp. one programmable by a computer.
Radio Frequency: Radio Frequency (RF) is a rate of oscillation in the range of about 3 kHz to 300 GHz
Device: An instrumentality invented for a particular purpose
Wireless: Wireless is a term used to describe telecommunications in which Electromagnetic waves carry the signal over part or all of the communication path.
Module: A self-contained component (unit or item) that is used in combination with other components
LED: Light Emitting Diode
LCD: Liquid Crystal Display
USB: Universal Serial Bus; a way of attaching peripheral devices to a computer
OrCAD : Oregon + CAD, OrCAD is a proprietary software tool suite used primarily for electronics design automation
PCB: Printed circuit board (PCB) provides both the physical structure for mounting and holding the components as well as the electrical interconnection between the components.
Mikro C : MikroC is a powerful, feature rich development tool (Compiler) for PICmicros.
Bootloader : The bootloader receives a user program from the PC and writes it in the flash memory, then launches this program in execution.
PIC Burner : PIC Burner is very versatile software. We can use different kinds of hardware with it, because the pins used on parallel port can be set using a simple ini-file.
PIC : Peripheral Interface Controller, A Micro-Controller
Communication : The activity of communicating; the activity of conveying information
Automation : The act of implementing the control of equipment with advanced technology; usually involving electronic hardware
Transmitter : Any Device Set used to broadcast radio or tv signals
Receiver : Any Device Set that receives radio or tv signals

Bonus Section #3

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Data Sheet –

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http://www.rentron.com/
http://howstuffworks.com/
http://Mikroelektronika.com/